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ABSTRACT

A study assessed labor shortages in the United States by conducting case studies of four occupations: special education teachers, paraprofessional home care workers, electrical and electronic engineers, and tool and die makers. The research approach combined analysis of existing data sources and interviews with individuals knowledgeable about the labor markets for the occupations. Theoretical background on the causes and consequences of labor shortages was examined. Research indicated the presence of occupational shortages in two of the four occupations--special education teachers and home care workers. In these two occupations, labor market conditions were more directly influenced by government intervention and other institutional barriers. Although strongly linked to low wage levels, shortages of home care workers also resulted from an explosive growth in the demand for home health care services and poor working conditions. Shortages of special education teachers were linked to inflexibility in wages, "burnout," and government actions that have increased the demand for these teachers. Labor shortages could result in loss of production of goods and services. Employers were more likely to implement strategies to respond to shortages that involved relatively short-term commitment of resources. Strategies to anticipate or recognize labor shortages and approaches to reduce or eliminate shortages were suggested. (Appendixes include the instrument used with tool and die makers.) (YLB)

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Labor Shortage Case Studies

Research and Evaluation Report Series 93-E

U.S. Department of Labor
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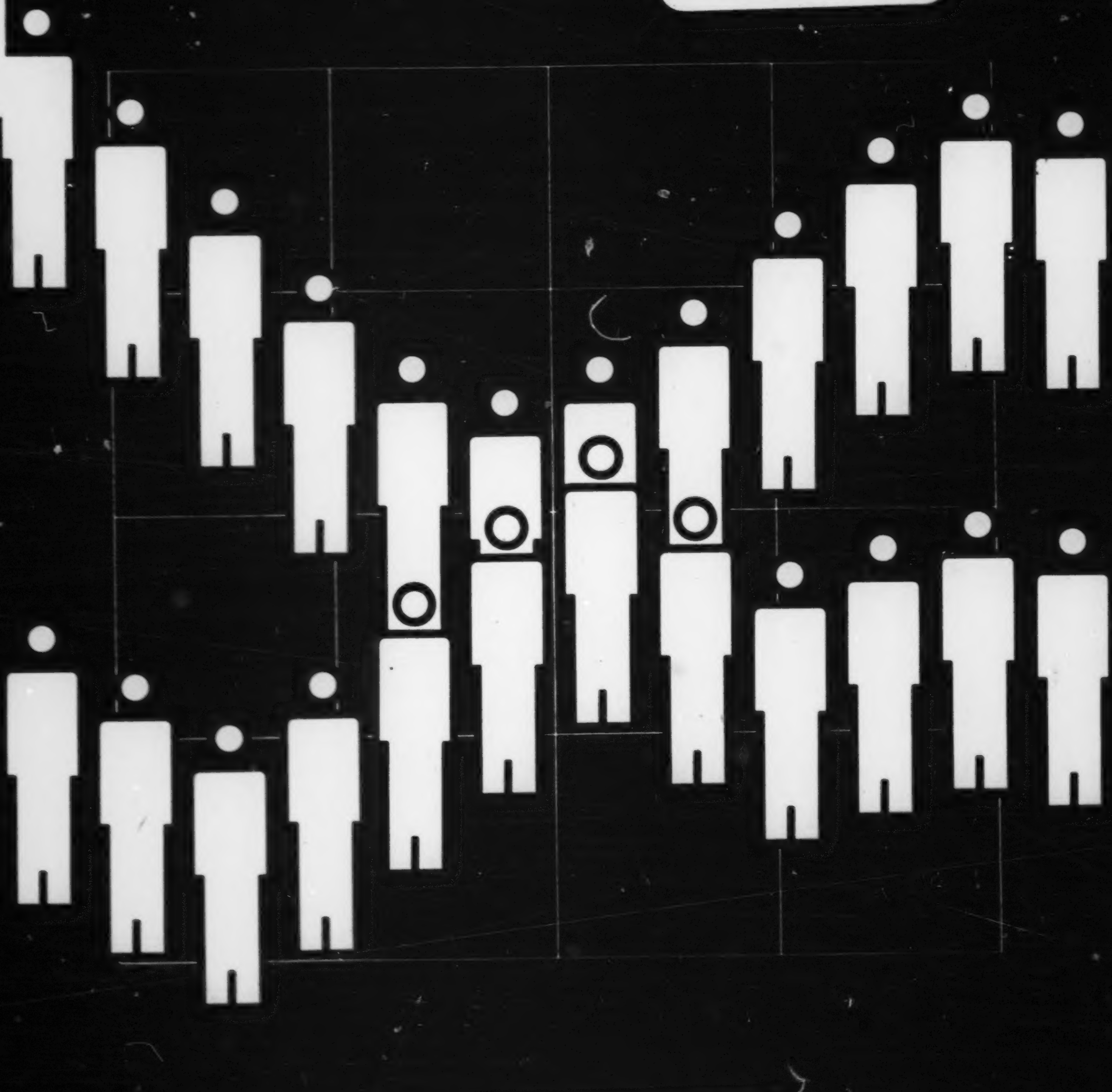

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Labor Shortage Case Studies

Research and Evaluation Report Series 93-E

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1993

RESEARCH AND EVALUATION REPORT SERIES

The Research and Evaluation Report Series presents information about and results of projects funded by the Office of Strategic Planning and Policy Development (OSPPD) of the U.S. Department of Labor's Employment and Training Administration. These projects deal with a wide range of training, employment, workplace literacy, labor market, and related issues. The series is published under the direction of OSPPD's Dissemination Unit.

This report in the series was prepared by James Bell Associates, of Arlington, Va., and Lewin-ICF (now Lewin-VHI), of Fairfax, Va., under Department of Labor Contract No. 99-9-4701-75-077-01. The authors are John W. Trutko, of James Bell Associates, and Burt S. Barnow, Any B. Chasanov, and Abhay Pande, of Lewin-ICF.

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Contractors conducting research and evaluation projects under federal sponsorship are encouraged to express their own judgment freely. Therefore, this report does not necessarily represent the official opinion of the Department of Labor.

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EXECUTIVE SUMMARY

PURPOSE

This report presents the findings of a study sponsored by the Employment and Training Administration (ETA) to enhance understanding of the factors that contribute to occupation-specific labor shortages. It also identifies steps that can be taken to reduce the probability of such shortages occurring, and if they do occur, to alleviate their effects. The report is based on case studies of four occupations that currently or previously experienced labor shortages: special education teachers, paraprofessional home care workers, electrical and electronic engineers, and tool and die makers. Research for the case studies was conducted in 1990.

BACKGROUND

The term "labor shortage" has no universally agreed-upon definition. It sometimes refers to a shortfall in the total number of individuals in the labor force, and sometimes denotes the possible mismatch between workers and jobs in the economy. Even when the term is used to refer to a particular occupation, a number of definitions have been proposed and used. For this report, we use a definition of a labor shortage provided by the Department of Labor in the Request for Proposals (RFP) for this study: "a market disequilibrium between supply and demand in which the quantity of workers demanded exceeds the supply available and willing to work at a particular wage and working conditions at a particular place and point in time." This study combines analysis of existing data sources with interviews of individuals knowledgeable about the labor markets of the four occupations selected.

RESULTS IN BRIEF

Our research indicates the presence of occupational shortages in two of the four occupations studied -- special education teachers and home care workers. While there was evidence of spot shortages in the two other occupations studied -- electrical and electronic engineers and tool and die makers -- there did not appear to be general shortages. A variety of underlying factors, particularly government intervention and institutional barriers, were found to lead to labor shortages. For example, wages paid to special education teachers and home care workers are substantially affected by the public sector, while wages paid to electrical and electronic engineers and tool and die makers are largely determined by private-sector employers. There are, however, other underlying (non-monetary) conditions that affect the willingness of workers to enter and remain within an occupation (e.g., job status, regularity of hours, certification requirements, lengthy and costly training periods, and working conditions). There are also a variety of demand-side conditions that can substantially affect the need for particular types of workers (e.g., increased demand for particular types of goods, changes in technology and emergence of new specialties within fields, decreases in government spending, and slow economic growth).

At the most general level, the consequence of a labor shortage is that particular goods and services are not provided. Such shortages, however, can also have impacts on the quality of life and create bottlenecks in the production of other goods and services. There are a variety cf steps that the private and public sectors can undertake to reduce or eliminate occupational shortages. For example, in addition to increasing salaries and fringe benefits, employers can intensify recruitment, provide training, and increase overtime. The public sector can expand information available to help employers and workers better anticipate and recognize shortages. Where regulation may substantially affect either wage levels or entry requirements for professions, government agencies should closely monitor the effects of such regulation.

PRINCIPAL FINDINGS

1. Occupational Shortages Were Found in Special Education and Home Care Occupations; Evidence for Shortages Was Less Certain in Electrical and Electronic Engineering and Tool and Die Occupations

Overall, we found two occupations -- special education teachers and home care workers -- where there are clear shortages of workers to fill available positions. In the other two occupations -- electrical and electronic engineers and tool and die makers -- the evidence for shortages is less certain. In the case of electrical and electronic engineers, while there is evidence of spot shortages, especially in some emerging technological areas, there now appears to be an overall surplus of available manpower because of recent cutbacks in defense spending and the recession. The primary concern is whether, and to what extent, shortages may emerge in the future. For tool and die makers, while there also appear to be spot shortages and considerable difficulty in hiring experienced workers, there does not appear to be a general shortage. However, employers have major concerns over their ability to replace an aging workforce with younger workers who possess the requisite basic skills to learn the profession.

2. A Variety of Underlying Factors -- Particularly Government Intervention and Institutional Barriers -- Lead to Labor Shortages

In the two occupations where there is clear evidence of labor shortages, labor market conditions are more directly influenced by government intervention and other institutional barriers than in the two occupations where shortages are less clearly in evidence. In both shortage occupations, wages paid to workers are directly limited by what the public sector is willing and able to pay for the services produced by these occupations. In contrast, in the two occupations where shortages are less of a problem, wages paid to workers are determined by a large number of private-sector employers.

For **home care workers**, we found evidence of shortages in many areas of the country -- especially in rural areas, on the West Coast, in the Great Lakes states, and in states with low unemployment rates. Low wage levels, primarily because of government regulation, appear to be the most significant factor contributing to shortages. Wages paid to home care workers, particularly those serving patients covered by Medicaid and Medicare, are generally not much different from those paid to workers in fast food restaurants and are often less. The following conditions have led to a substantial increase in the demand for home care workers:

- a dramatic increase in the size of the elderly population (especially those over 75 years of age), who are the major users of home health care services;
- a decline in the availability of informal home care (e.g., greater female labor participation rates have reduced the ability of women to care for the disabled and elderly);
- adoption of cost containment policies under Medicaid and Medicare, which have resulted in a greater reliance on less expensive home care rather than on institutional (i.e., inpatient hospital and nursing home) settings; and
- expansion both in the eligibility for and the range of home care services provided under federal and state health care programs.

At the same time, there are a host of underlying conditions that affect significantly the ability and/or willingness of workers to become home care workers, including:

- extremely unstable work environments, particularly in terms of irregular hours;
- near poverty-level wages and few fringe benefits;
- need for transportation, especially within rural settings; and
- limited advancement potential and low job status.

Hence, shortages of home care workers, while strongly linked to low wage levels, also result from an explosive growth in the demand for home health care services and poor working conditions that limit willingness and ability to work within the field and result in high rates of turnover among home care workers.

In the case of **special education teachers**, we found that shortages -- which vary considerably by geographic area within the country -- are partially linked to inflexibility in wages, although wages are not quite as important a factor as they are for home care workers. Probably more important are other factors that affect the demand for these workers and the willingness of workers to enter and remain within the field. A particular problem within the field of special education is "burnout," which results in high levels of turnover. We found that the demand side is substantially influenced by government actions, particularly federal and state laws that have increasingly mandated quality standards for special education. This has resulted in maximum class-size standards for special education classes, which increase the demand for special education teachers. In addition, increasing emphasis on early intervention with the developmentally disabled has increased the demand for special education teachers. On the supply side, while there is a large pool of qualified special education teachers, there is a major challenge both to attracting and to keeping fully certified special education teachers within the field. The most often cited factor affecting the supply of special education teachers is high attrition. In addition, there are a number of other factors that affect the ability or willingness of workers either to enter or to stay within the special education field, including:

- varying state certification requirements, which discourage geographic mobility;
- lengthy training periods, with many states mandating a total of five or six years of college study;

- limited wage differentials for special education teachers compared to their general education peers, despite additional stresses and greater training requirements; and
- the loss of prestige that was formerly attached to teachers and teaching.

Institutional rigidity in adjusting wages for special education teachers plays an important role in creating shortages. School boards, because of limits on local revenues and pay equity concerns, are generally reluctant to adjust wages for special education teachers, even where shortages exist.

In the case of **electrical and electronic engineers**, we concluded that there is not currently a shortage. However, because of shifting demand and supply conditions, some analysts feel that shortages are likely to emerge soon (by the mid-1990s) and last well into the next decade. In comparison to the home care and special education occupations, there appear to be relatively few government or institutional restrictions on wages paid to electrical and electronic engineers. Despite the ability of employers to increase wages to adjust to labor market conditions, there are concerns about the following demand-side conditions:

- continued projected growth in demand for electronic and electrical products, which is expected to result in annual employment growth for electrical and electronic engineers about double the average for all U.S. occupations;
- an increase in replacement demand due to increasing retirements; and
- rapid emergence of new fields and specialties, together with obsolescence of existing skills of engineers within the field.

At the same time that demand for electrical and electronic engineers is expected to increase substantially, there are potential constraints on the number of new engineering graduates at all levels. Because of the changing age distribution of the U.S. population (i.e., a decrease in the size of the age cohort entering college/university in the 1990s), there is concern over the possibility of a substantial decrease in the number of new engineering graduates at all degree levels. Further, some analysts argue that there is relatively little time to react to the projected shortfall of engineers because of the long lead time in training.

Finally, in the case of **tool and die makers**, while the evidence does not appear to support the claim by some employers that there is a severe shortage, there are some supply-side conditions which could result in future labor shortages. Unlike the three other occupations studied, there appear to be few demand-side factors that have or are likely to result in shortages of tool and die makers. The primary source of concern within this field is on the supply side: will there be sufficient entry of new workers to the field to replace the large number of retiring tool and die makers? Major concerns are the following:

- an apparent bias on the part of younger workers (and their parents) against "blue collar" employment, which constrains the number of workers willing to enter the profession;
- lack of knowledge about employment opportunities within the machine trades, especially among high school administrators, counselors, and parents;
- poor basic skills among the pool of youth likely to enter the machine trades;
- the relatively long and costly training period for tool and die makers, which affects willingness to enter the field and makes it difficult for firms (especially smaller ones) to provide the types of training needed to become tool and die makers; and
- lack of vocational training facilities, especially within high school settings.

The key question within this occupation is whether adequate information and incentives can be provided by employers to attract younger workers to the tool and die occupation and, once attracted, whether these workers will have the necessary basic skills and determination to master the various technical skills that are required.

3. Labor Shortages May Result in Loss of Production of Goods and Services

At the most general level, the consequence of a labor shortage is that particular goods and services are not provided. The impact of not providing goods and services varies by occupation. A shortage of special education teachers, for example, results in some school districts being unable to fill teaching positions with fully qualified teachers. This, in turn, may result in larger class size than mandated by law or in instruction of the learning disabled by unqualified teachers. This could lead to greater costs to society in the long run if the learning disabled are less productive and more dependent. In the case of home care workers, shortages may result in denial or delay of necessary care, reduction in the level of home care services received by clients, and/or diminished quality of care. The result for the elderly and others in need of assistance is a decrease in the quality of life. Shortages of electrical and electronic engineers or tool and die makers may lead to bottlenecks in the production of goods and services, and ultimately to loss in productive capability of U.S. industry. In turn, this may result in job losses for other U.S. workers, loss of domestic production of goods and services, and increases in imports.

4. Employers Utilize a Variety of Strategies to Respond to Shortages Depending Upon the Conditions That Brought About the Shortage and the Extent to Which the Employer Is Affected by the Shortage

In our case studies, we found a variety of employer responses to shortages. The responses adopted depend upon the conditions that brought about the shortage and the extent to which the employer is affected by the shortage. Employers are more likely to implement strategies that involve relatively short-term commitments of resources (e.g., intensified recruitment, use of overtime, and signing bonuses) than longer-term commitments of resources (e.g., increase in salaries and fringe benefits which affect all employees, and intensified training).

CONCLUSIONS AND RECOMMENDATIONS

We first discuss strategies that may help to anticipate shortages or recognize them. We then suggest approaches that may be appropriate for reducing or eliminating shortages once they are present.

1. Anticipating Labor Shortages

We conclude that we cannot project occupational supply and demand well enough to anticipate shortages adequately. Cohen's work[1] points to how labor market projections and data can be used to identify occupations that are prone to future shortages. For example, occupations that are good candidates for shortages are likely to experience wage increases as the labor market tightens. ***Thus, we recommend that further research on "leading indicators" of shortages be supported.*** However, given economists' current lack of ability to develop reasonably accurate projections, we recognize that projections should be treated as general indicators rather than precise forecasts.

2. Recognizing Labor Shortages

It is not a simple matter to determine if an occupation is experiencing a shortage. By the definition used in this study, an occupation has a shortage if the number of workers employed falls short of the number of workers employers would like to hire at the prevailing wage. The key information required to assess whether an occupation is experiencing a shortage is therefore vacancy data. Although the Bureau of Labor Statistics (BLS) formerly collected vacancy data, the program was discontinued several years ago for budgetary reasons. Because vacancies are the most important data for determining if shortages are present, the lack of these data makes it very difficult to determine which occupations have shortages. ***We therefore recommend that consideration be given to reestablishing BLS data on occupational vacancies.*** If a complete occupational vacancy series is not feasible, perhaps BLS and ETA could strongly urge employers to list vacancies for occupations of special interest (e.g., engineering specialties) with the state employment security agencies, and the results for these occupations could then be compiled at the national level.

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[1] See Malcolm S. Cohen (1990). Study on the Feasibility of Using Labor Market Information for Alien Certification Determination. Ann Arbor, Michigan: Institute of Labor and Industrial Relations, University of Michigan.

3. Strategies for Reducing or Eliminating Occupational Shortages

To minimize problems with shortages resulting from government regulation, we recommend the following actions:

- ***Governments that directly or indirectly regulate wages in an occupation should monitor the services provided to assure that shortages are not leading to unmet needs (e.g., waiting lists for needed services).***
- ***In periods of rapidly rising wages, governments should make sure that adjustments to wages are made frequently enough to keep them competitive.***
- ***If wage increases are considered undesirable because of the cost implications, government regulators should consider actions to assure that services are provided equitably. For example, programs can be reduced in scope to reduce demand for the occupations experiencing shortages.***

Although the unregulated occupations covered by our case studies are not currently experiencing shortages, the literature indicates that fields such as engineering have experienced shortages in the past. Shortages are most likely to occur in occupations with long training periods and long reaction and response lags by firms, students, and workers. We have already noted that the lack of vacancy data makes it difficult to ascertain when a shortage exists and recommended reinstituting some form of vacancy statistics.

In many instances shortages will be self correcting. As we explain in Chapter 2, employers have incentives to raise wages, improve recruiting, and take other actions to eliminate the shortage. ***Thus, before taking strong action, government policymakers should review projections of occupational supply and demand to determine if the shortage is likely to be corrected by normal functioning of the labor market.***

Federal and state governments can assist employers and workers to adjust to shortages by publicizing occupations where shortages exist or are likely. BLS publications such as the Occupational Outlook Handbook and Occupational Outlook Quarterly can be valuable tools to employers, workers, and students. In addition, state employment services, the National Occupational Information Coordinating Committee (NOICC), and NOICC's state counterparts -- the State Occupational Information Coordinating Committees (SOICCs) -- provide occupational data and projections for workers, firms, and students. Although it is extremely difficult to evaluate the effectiveness of these institutions, an evaluation might reveal ways in which these organizations could be improved. ***The Department of Labor should consider evaluating the effectiveness of its occupational information programs with the goal of identifying any shortcomings and improving the flow of information to workers, students, and employers.***

Another potential bottleneck to alleviating shortages is a lack of appropriate training and educational programs. In some instances employers can train workers themselves, but in many occupations employers are dependent on schools and independent training programs. ***If a shortage is likely to persist, and one of the problems is a lack of adequate education and training programs, government can help eliminate the shortage by increasing support for these programs.*** The Employment and Training Administration has recently taken steps to upgrade the apprenticeship system in the United States, and this may help avoid shortages in some skilled occupations. On a selective basis, the government can also support growth in institutions of higher education to increase the capacity to train professionals in selected fields.

Finally, permitting additional immigration for individuals in shortage occupations can provide additional workers relatively quickly. Immigration policies are often controversial, however, because increasing the supply when there is not a shortage can reduce the earnings of workers currently in the occupation. Even if there is a shortage, it may only be temporary, and workers may find their wages reduced in the future. ***Liberalizing immigration policies can be used to eliminate shortages, but care should be taken to ascertain that a shortage exists and that it is expected to persist.***

As we noted at the beginning of this study, labor markets are highly dynamic. To some extent, labor shortages are inevitable as labor demand by employers and labor supply of workers adjusts. In most instances, the natural working of the market will eliminate the shortage, but in some cases government actions can help reduce the time required or remove barriers to the process.

CHAPTER 1

INTRODUCTION

Major changes in the economy in recent years have generated more than the usual interest in how well the U.S. labor market is functioning. Three general issues have been widely discussed by economists and policy makers. First, because of recent declines in the U.S. birth rate, some analysts are concerned that there will simply be too few workers to maintain growth in the American economy.[1] Second, there has been a growing concern that there is or will be a serious mismatch between the skills of the American labor force and the needs of employers, resulting in a serious "skill gap" characterized by unfilled vacancies in many high-skill occupations along with high unemployment for less-skilled workers.[2] Finally, there has long been concern that shortages sometimes develop and persist in specific occupations, leading to market inefficiencies in the U.S. economy. It is this third topic, occupation-specific shortages, that is the subject of this report.

This report presents the findings of a study sponsored by the Employment and Training Administration (ETA) of the U.S. Department of Labor (DOL) to enhance understanding of the factors that contribute to occupation-specific labor shortages. It also is intended to identify steps that can be taken by employers and the government to reduce the possibility of such shortages occurring in the first place, and once they do occur, to alleviate their effects. The conclusions in this report are based on in-depth case studies of four occupations that are currently or in the past have experienced labor shortages: special education teachers, paraprofessional home care workers, electrical and electronic engineers, and tool and die makers.

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[1] See Sar A. Levitan and Frank Gallo (Sept. - Oct. 1989). "The Shortsighted Focus on Labor Shortages." Challenge, pp. 28-32.

[2] See, for example, Commission on Workforce Quality and Labor Market Efficiency (1989). Investing in People: A Strategy to Address America's Workforce Crisis. Washington, D.C.: U.S. Department of Labor; and William B. Johnston and Arnold Packer (1987). Workforce 2000: Work and Workers in the Twenty-First Century. For a critical review of this literature, see Burt S. Barnow and D. Lee Bawden (1991). "Skill Gaps in the Year 2000: A Review of the Literature." Washington, D.C.: The Urban Institute.

This chapter begins with a brief overview of the concept of labor shortages, focusing on the alternative definitions that have been used to identify occupational-specific labor shortages. A more detailed discussion of the causes and consequences of such labor shortages is provided in Chapter 2. This chapter concludes with a discussion of the study objectives, scope, and methodology.

A. Background on Labor Shortages

The term "labor shortage" has no universally agreed upon definition. It sometimes refers to a shortfall in the total number of individuals in the labor force, and sometimes denotes the possible mismatch between workers and jobs in the economy. Even when the term is used to refer to a particular occupation, a number of definitions have been proposed and used. In this report, we use a definition of a labor shortage provided by the Department of Labor: "a market disequilibrium between supply and demand in which the quantity of workers demanded exceeds the supply available and willing to work at a particular wage and working conditions at a particular place and point in time."[3]

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[3] This definition, which was provided by DOL in the Request for Proposals (RFP) for this study, is essentially identical to the definition used by Franke and Sobel in their study of labor shortages: "A situation existing over an extended period of time in which employers were unable to hire at going wages or salaries sufficient numbers of qualified persons to fill positions for which there were budgeted funds and for which personnel were required to meet existing demands for services." See Walter Franke and Irving Sobel (1970). The Shortage of Skilled and Technical Workers. Lexington, Massachusetts: Heath-Lexington Books.

This definition considers a shortage as a disequilibrium condition where the amount of labor workers are willing to supply is less than employers are willing to buy at the prevailing wage. A market is said to be in equilibrium when the amount of labor that workers (i.e., sellers) are willing to provide at the market price is equal to the amount that firms (i.e., purchasers) wish to buy at the market price. When the quantities that workers wish to provide and firms wish to buy are not identical at the prevailing price, the market is said to be in a disequilibrium situation.

If the quantity of labor offered exceeds the quantity that firms wish to purchase, there is a surplus, and if the quantity of labor desired by firms exceeds the amount workers offer at the prevailing price, there is a shortage. In general, the quantity that workers are willing to provide is an increasing function of the wages (i.e., price) they can obtain, and the relationship between the amount that workers are willing to provide at various prices, with other factors held constant, is referred to as the supply curve.[4] Exhibit 1.1 shows a typical upward-sloping supply curve for labor. As the wage rate is increased, more workers are willing to enter a particular occupation and current workers are generally willing to provide more labor.

In Exhibit 1.1 the amount of labor that employers will wish to hire at alternative prices is indicated by the downward-sloping demand curve. Demand curves slope down because as the price of a factor increases, the employer will generally substitute other factors of production for the factor whose price has increased. In addition, higher factor prices will generally lead to higher product prices, which in turn will lead to a reduction in

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[4] Technically, the supply curve for labor may be "backward bending," which means that at very high wages workers actually reduce the amount of labor they are willing to supply. We do not consider this concept further in our discussion because it is unlikely to be relevant in a study of labor shortages.

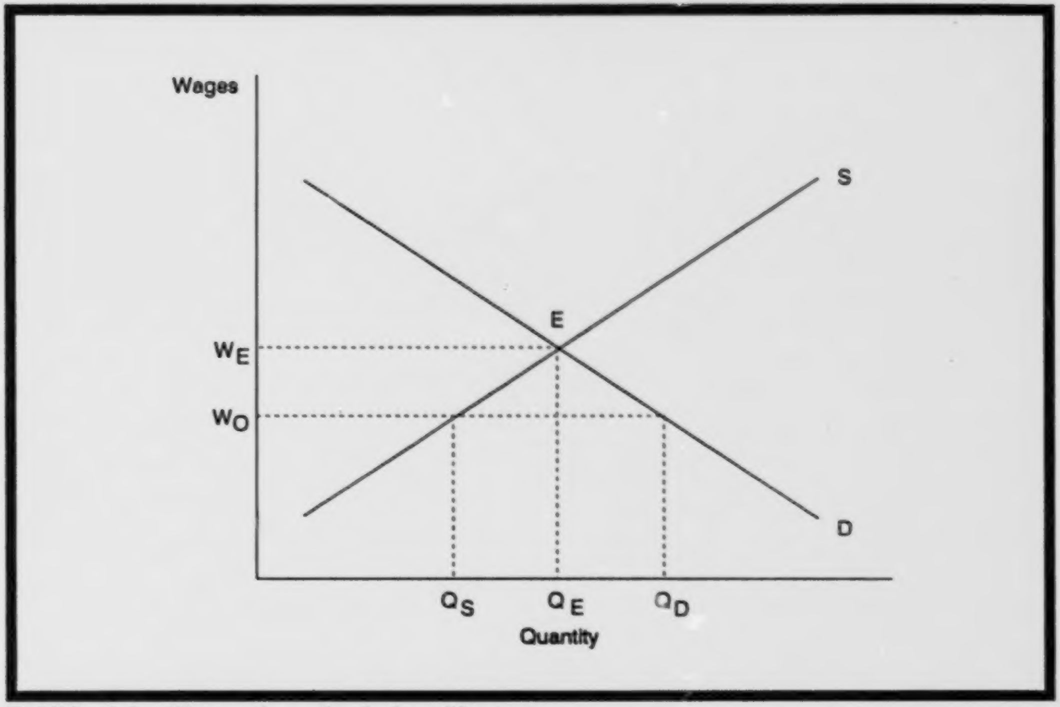

Exhibit 1.1: Illustration of a Labor Shortage

the quantity of the product demanded and the factors of production.

The point labeled E in Exhibit 1.1 is the market equilibrium point. If the wage is equal to W_E then the quantity of labor that workers are willing to supply at that wage (Q_E) is exactly equal to the quantity of labor that employers will wish to hire. The market is said to be in equilibrium because the quantity supplied is equal to the quantity demanded.

If for some reason the prevailing wage rate in the market is W_0 rather than W_E then the quantity of labor workers are willing to supply is equal to Q_s -- the point on the supply curve corresponding to W_0. Employers, however, would like to hire Q_D at that wage rate. The difference between the amount of labor that employers wish to hire and the amount that workers are willing to provide (Q_D - Q_s) is the amount of the shortage. In the next chapter we discuss how such shortages might arise.

Economists and other analysts have proposed several alternative definitions of occupational shortages.[5] Although these definitions are not used in this report, it is important to note that others use the term differently. It is particularly important to keep the definition in mind when interpreting other studies of shortages and the interviews we conducted for this study.

1. The Social Demand Model

Some analysts consider a shortage to be present if the number of workers in an occupation is less than what is considered the socially desired number. Under this definition, a shortage of engineers exists if the analyst making the determination concludes that society would be better off if there were more engineers. This type of definition does not imply that the labor market is in disequilibrium; instead it describes a situation where the person who claims there is a shortage does not like the market's results. Arrow and Capron explain the problem with this definition as follows:

> In particular, careful reading of such statements indicates that the speakers have in effect been saying: There are not as many engineers and scientists as this nation should have in order to do all the things that need doing such as maintaining our rapid rate of technological progress, raising our standard of living, keeping us militarily strong, etc. In other words, they are saying that (in the economic sense) demand for technically skilled manpower *ought* to be greater than it is -- it is really a shortage of *demand* for scientists and engineers that concerns them.[6]

The Secretary of Health and Human Services' Commission on Nursing states in its final report that: "In the most general terms, a registered nurse [RN] shortage exists when the supply of RNs is insufficient to meet the 'requirements' for RNs. RN requirements can be defined based on either economic demand or clinical need."[7] The Commission rejected the use of clinical need for defining a shortage because they concluded that there is no objective method of quantifying the degree of the shortage and relating it to specific factors.

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[5] There are different definitions of labor surpluses as well. For example, the Bureau of Labor Statistics concludes that the nation has a surplus of college graduates while John Bishop concludes that there is a shortage. For a review of this area see Barnow and Bawden (1991).

[6] See Kenneth J. Arrow and William M. Capron (May 1959). "Dynamic Shortages and Price Rises: The Engineer-Scientist Case." Quarterly Journal of Economics.

The fact that we do not use this type of definition for a shortage does not mean we do not believe that it is unimportant for the nation to consider whether it is satisfied with market-produced results. Quite the contrary. We believe it is important for society to consider whether or not the market solutions are desirable, and, if not, to take appropriate actions.[8] The concern in this study is with the operation of labor markets, the reasons why they sometimes fail to achieve equilibrium, and actions that can be taken to improve their efficiency.

2. The Blank-Stigler Model

One of the first major studies of occupational shortages was conducted by David S. Blank and George J. Stigler.[9] Blank and Stigler define a shortage as follows: "A shortage exists when the number of workers available (the supply) increases less rapidly than the number demanded at the salaries paid in the recent past." Blank and Stigler then argue that to alleviate the shortage, wages in the occupation must rise and some of the work formerly performed by the occupation with the shortage will now be performed by others.

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[7] See U.S. Department of Health and Human Services, Secretary's Commission on Nursing (Dec. 1988). Final Report. Vol. 1, p. 3.

[8] See Barnow and Bawden (1991) for a review of recent studies that have concluded that the United States should increase education and training.

[9] See David J. Blank and George J. Stigler (1957). The Demand and Supply of Scientific Personnel. New York: National Bureau of Economic Research.

The Blank-Stigler shortage concept is illustrated in Exhibit 1.2. Initially the market is in equilibrium at E with wage rate W_E and Q_E workers. If demand increases, the demand curve will shift to the right to the line D_1. A shortage will result if the wage remains at W_E because employers will wish to hire Q_1 workers -- but only Q_E workers will be available at that wage. Market pressures will then lead to an increase in the wage, and equilibrium will eventually be restored with a new wage of W_2 and Q_2 workers.

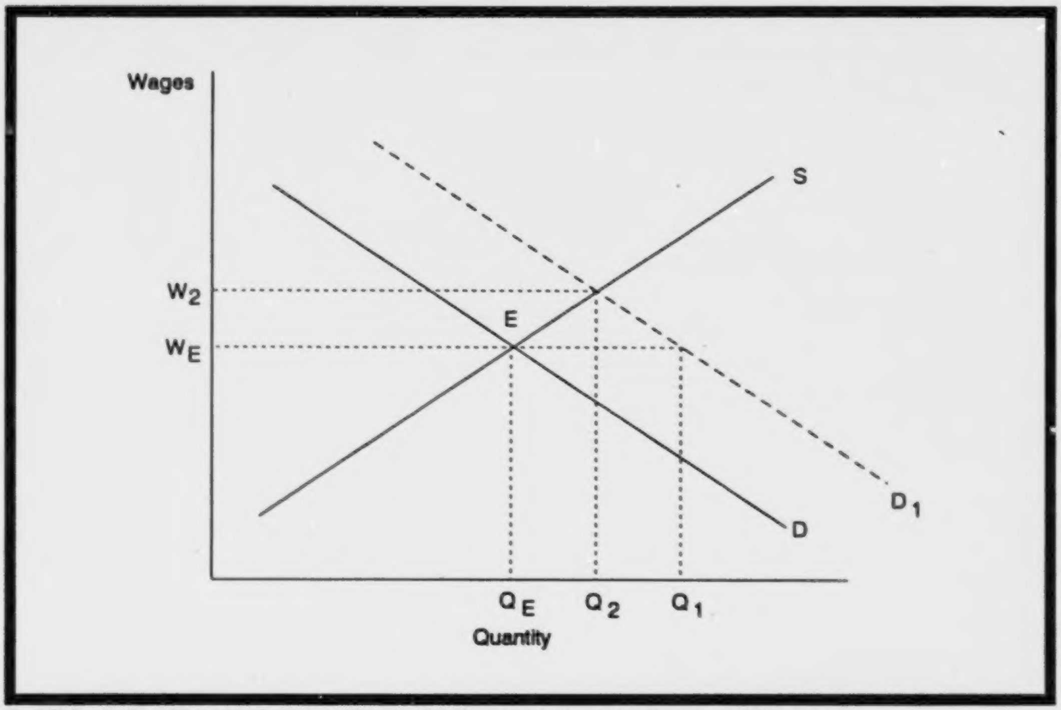

Exhibit 1.2: Illustration of Blank-Stigler and Arrow-Capron Shortages

There are several problems with the Blank-Stigler model. First, as discussed in the next chapter, an increase in demand is only one of the possible causes of a shortage. Thus, the Blank-Stigler model ignores other possible causes of occupational shortages. Second, Blank and Stigler indicate that a shortage can be identified by rising wages in the affected occupation. Wages may not rise, however, because of market imperfections such as controls on wages or imperfect information.

3. The Arrow-Capron Dynamic Shortage Model

Kenneth J. Arrow and William W. Capron developed an alternative model of occupational shortages.[10] Their definition, which they refer to as a dynamic shortage, is based on the premise that "a steady upward shift in the demand curve will produce a shortage, that is, a situation in which there are unfilled vacancies in positions where salaries are the same as those currently being paid in others of the same type and quality."

The Arrow-Capron model is also illustrated in Exhibit 1.2. Like the Blank-Stigler model, the Arrow-Capron model is characterized by increased demand. However, Arrow and Capron note that markets are characterized by a "reaction speed," and that institutional arrangements (such as long-term contracts) and the time it takes for information to spread will affect the time required for employers to adjust wages. Thus, Arrow and Capron conclude that shortages will be characterized by vacancies. In Exhibit 1.2, the number of vacancies initially resulting from the increase in demand will be equal to $Q_1 - Q_E$. If demand continues to grow, then the market may not achieve equilibrium.

The Arrow-Capron dynamic shortage model is consistent with the general model we use, but it may be considered a specific case. In the next chapter we show how shortages can also result from decreases in labor supply and constraints on prices.

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[10] See Arrow and Capron (1959).

4. Other Definitions of Shortages

In addition to the definitions presented above, several other definitions for shortages have been proposed. Paul E. Harrington and Andrew M. Sum review several other possible definitions of occupational labor shortages, and two of them are briefly discussed below.[11]

a. The Rate of Return Model

The rate of return model is based on the application of internal rate of return analysis to alternative occupations. The costs of investing in a particular occupation are defined as the sum of the direct costs for higher education, training, and supplies, plus the indirect costs of foregone wages that are incurred during periods of training. The benefits are the earnings typically derived from the occupation each year. The internal rate of return is then calculated by finding the interest rate that equates the present value of the costs and benefits.[12] Occupations with shortages are thus defined as those occupations with higher than average rates of return.

Harrington and Sum note that the rate of return approach is "beset with numerous methodological and measurement difficulties." One important problem is that we cannot observe the future earnings streams from various occupations. Relying on cross-sectional or historical data may provide a misleading picture of what the earnings will eventually be. In addition, the returns to various occupations may differ for reasons having little to do with a shortage. For example, some occupations may pay higher wages because they have high health or safety risks -- what economists refer to as compensating differentials.

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[11] See Paul E. Harrington and Andrew M. Sum (1984). Skills Shortages and Employment and Training Policy in the U.S.: Past Relationships and Desirable Future Directions. Boston: Center for Labor Market Studies, Northeastern University.

[12] Formally, the internal rate of return is found by solving the equation $0 = (W_0 - C_0) + (W_1 - C_1)/(1+i) + (W_2 - C_2)/(1+i)^2 + \ldots + (W_n - C_n)/(1+i)^n$, where W_t represents earnings in year t, C_t represents costs incurred in year t, and i is the internal rate of return that is solved for.

b. The Monopsonistic Labor Model

A market where there is only one firm for a particular good or type of labor is referred to as a monopsony. The monopsonist differs from an employer in a competitive labor market because the monopsonist can set the wage rather than act as a price taker.

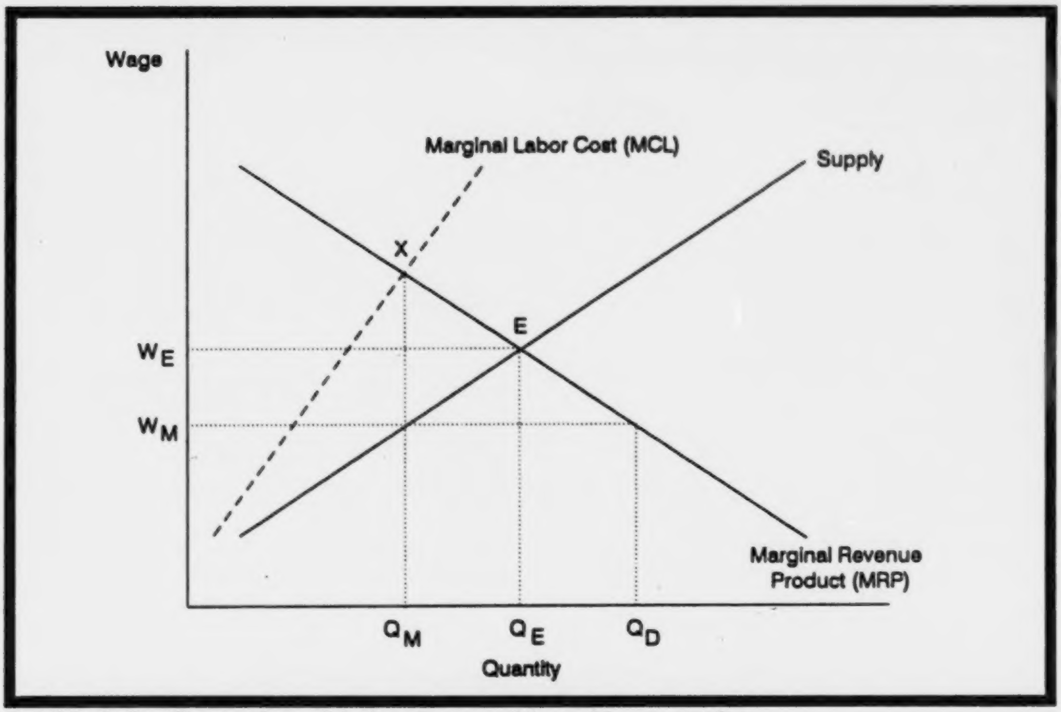

Exhibit 1.3: Illustration of Labor Demand by a Monopsonist

The situation for a monopsonist is illustrated in Exhibit 1.3.[13] Because the monopsonist is the only buyer for the occupation of interest, the monopsonist observes the labor supply curve for the occupation; this is in contrast to an employer in a competitive market who can hire all the labor desired at the market wage. Because the monopsonistic employer must pay all workers the same wage, the monopsonist faces a steep upward sloping marginal labor cost curve -- if an additional worker is hired, wages must be increased for all currently employed workers as well as the marginal worker. Exhibit 1.3 also illustrates the marginal revenue product curve for the firm. To maximize profits, the monopsonist employer will hire labor until the marginal labor cost is equal to the marginal labor product, corresponding to the point X in the exhibit. The wage paid by the monopsonist will then be W_M and Q_M workers will be hired. Note that the number of workers hired is less than in a competitive market (Q_E) and the wage is lower than the competitive wage (W_E).

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[13] For a more detailed discussion of monopsonistic employers, see Ronald G. Ehrenberg and Robert S. Smith (1988). Modern Labor Economics: Theory and Public Policy. Third Edition. Glenview, Illinois: Scott Foresman and Company.

The monopsonist might consider the resulting situation to be a shortage because the monopsonist would like to hire more workers at the monopsony wage. However, because the monopsonist faces an upward sloping labor supply curve, the wage must be increased to attract additional labor into the occupation. Ronald G. Ehrenberg and Robert S. Smith conclude that the labor shortage faced by a monopsonist is "more apparent than real." In addition, Ehrenberg and Smith point out that monopsony situations are likely to be very rare.

5. Summary

After careful consideration, we have elected to retain the definition of a labor shortage provided by DOL. Some of the labor shortage concepts that have been proposed, such as looking at the total amount of labor supplied and the potential economy-wide mismatch between employer needs and worker qualifications, are important, but they are not the issues that the Department of Labor wanted addressed in this particular study.

Like the Secretary of Health and Human Services' Commission on Nursing, we have elected not to use the social demand concept because there is no objective way of determining the optimal number of workers in various professions.

Definitions proposed in the 1950s by Blank and Stigler and by Arrow and Capron are closer to the concept of a labor shortage that is used here. The principal advantage of these definitions is that they provide relatively straightforward tests for the existence of a shortage -- rising relative wages in the case of the Blank-Stigler definition and increasing vacancies in the case of the Arrow-Capron definition. However, we believe that these definitions are too narrow to capture all the types of shortages of interest. Both the Blank-Stigler and Arrow-Capron definitions do not include labor market situations classified as shortages by the other definition, and both omit situations where excess demand results from market imperfections. The more general definition employed here covers such cases.

The use of a broad definition does have some disadvantages. As Walter Franke and Irving Sobel note in using a similar definition, "The definition is neither altogether concrete and precise nor is it susceptible to precise measurements."[14] However, we also concur with Franke and Sobel's conclusion that: "Viewed in the context of a study whose purpose is to examine the degree to which labor market institutions respond to and facilitate adjustment to varying degrees of labor market tightness, the definition is, however, meaningful and operational."

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[14] See Franke and Sobel (1970), p. 7.

B. Study Objectives, Scope, and Methodology

1. Study Objectives and Scope

The primary objective of this study is to assess labor shortages in the United States by conducting case studies of four occupations: special education teachers, paraprofessional home care workers, electrical and electronic engineers, and tool and die makers. The study is intended to enhance our understanding of the factors that cause labor shortages and to identify employer and government policies that have alleviated or exacerbated them.

Our approach to the study combines analysis of existing data sources and interviews with individuals knowledgeable about the labor markets for the occupations selected. We address eight specific questions in the study:

- Are there common denominators across the studied occupations that can help us understand why they tend to recur or persist and which help us recognize and anticipate shortages in other occupations?
- Conversely, are there recognizably distinct kinds of labor shortages, with different characteristics and calling for different policy initiatives?
- Are there ways we can recognize when a supply imbalance is being corrected in one area, but where the corrective measure or measures are simultaneously causing an imbalance in another area?
- What were the responses to address the shortages used by employers, labor unions, training, etc.? What were the results?
- What public and private policies in the past have been implemented that have helped avoid or lessen the severity of these shortages?
- Have any policies contributed to increasing (or causing) labor shortages?
- How can all interested parties (such as employers, unions, educational institutions, government agencies, etc.) cooperatively and responsibly confront and resolve shortage issues?
- How can we best ensure that any policy implemented is working as intended? How can we track effects of policies?

This study does not provide definitive answers to all the questions raised by the Department of Labor. However, by limiting our analysis to four occupations, we have deliberately set out to study a limited number of occupations in depth rather than seek to understand how shortages work in all possible cases. In addition, we have deliberately selected occupations that are quite diverse in terms of educational requirements, type of labor market arrangements, and causes of shortages. This breadth provides a wide range of experiences for assessing the causes and consequences of labor shortages and the efficacy of potential policies by government and employers.

2. Data Collection and Methodology

We have relied on both primary and secondary data in carrying out the study. The two types of data are useful for meeting different objectives of the study, and they are likely to be complementary. Both types of data are useful for documenting the presence or absence of a shortage, but they have different strengths and weaknesses.

Published secondary data are useful for tracking historical trends and testing specific definitions such as the Blank-Stigler and Arrow-Capron definitions. On the other hand, published data cannot address issues not covered by the data sources (such as job vacancies), and they are not very useful in developing policy options. Data collected through interviews with knowledgeable people are helpful in gathering some information on topics not covered by the published data, and interviews with employers, trade associations, and union officials can be very useful in identifying and assessing potential policy initiatives. The secondary data analyzed for the study include data from national data bases that can be used to track occupations for several years and special data bases for particular occupations. For three of the occupations covered in this study (electrical and electronic engineers, special education teachers, and tool and die workers), we have made use of a unique data base developed by Malcolm S. Cohen as part of a study on the feasibility of using labor market information to identify occupations with shortages for the Department of Labor's alien certification program.[15] In the next chapter we discuss how these data series can be used to provide indications of shortages. In the subsequent chapters on specific occupations, the series and the inferences that may be drawn from them are described in more detail. The seven series compiled by Cohen and the sources are:

- **Occupational unemployment rate.** This provides the unemployment rate for members of the labor force based on their current or most recent occupation. The data are based on averages of monthly Current Population Survey (CPS) data published by the Bureau of Labor Statistics (BLS).
- **Occupational employment.** This series provides the levels and changes in employment in the occupations of interest. The data are based on averages of monthly CPS data.
- **Occupational wage rates.** This series provides median wages in the occupations over time. The data are derived from the CPS.
- **BLS projected employment growth.** BLS develops projections of occupational employment periodically.
- **Replacement demand.** This series was developed by Cohen based on several CPS surveys to measure the proportion of workers in an occupation who left the occupation between 1986 and 1987.[16]

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[15] Cohen drew his data from published and unpublished sources. He developed procedures to define occupations consistently in his report and to impute missing values. In the text we describe the basic series developed by Cohen rather than the specific indicators of shortages he develops. See Malcolm S. Cohen (1990). Study on the Feasibility of Using Labor Market Information for Alien Certification Determination. Ann Arbor, Michigan: Institute of Labor and Industrial Relations, University of Michigan.

[16] Cohen cautions that some of the estimates obtained for specific occupations are very large and may be spurious.

- **Labor certification by occupational group.** This series documents the number of aliens receiving certification to work in the United States for each occupation.

- **Annual additions to occupational labor supply.** This series provides estimates of the net addition to potential supply to occupations from completions of appropriate education and training programs.[17]

Occupation-specific data bases are also used for the analysis when available. For example, the U.S. Department of Education sponsors special surveys on teachers, and we present the relevant data on special education teachers.

In addition to the quantitative data on shortages from ongoing and special surveys, we conducted a number of interviews with individuals knowledgeable about each of the occupations of interest. The interviews were not based on random samples, but instead were conducted with several individuals willing to discuss the labor market situation for the occupations of interest. For all four occupations we interviewed representatives of employers and trade associations. Where relevant, we also interviewed government officials, researchers, educators, and representatives of unions.

We generally gathered candidates for interviews by contacting trade associations, researchers, and government officials. In addition to interviewing appropriate people in these organizations, we asked for suggestions of specific employers who would be good interview candidates. We sought to include candidates from various regions to see if shortage problems for the occupation are national or regional in scope. We also sought to obtain some diversity in firm/organization size and other dimensions of employers. Although the resulting sample is not likely to provide a representative sample of all employers, we believe it provides useful qualitative data for the occupations of interest.

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[17] Cohen points out that this measure is not always accurate because some occupations have alternative entry paths. The utility of the data for the occupations covered in this study is discussed in the relevant chapters.

The interviews were conducted by telephone, usually requiring 30 to 60 minutes. Some interviews ran longer because the interviewees were very interested in the study. The interviews were semi-structured. An interview guide was used to elicit information we considered relevant, but respondents were encouraged to speak their minds, and the discussions varied significantly in terms of topics covered and depth, depending upon the knowledge and interests of the respondents. The information obtained in the interviews is incorporated in the chapters on the relevant occupations.

Appendix A provides additional detail on the data sources used for this study and their limitations. Appendix B provides a sample of the discussion guide used during interviews with employers of tool and die makers.

3. Structure of the Report

The report has seven chapters. Chapter 2 provides theoretical background on the causes and consequences of labor shortages. The chapter discusses why shortages might develop in particular occupations, the adjustments that are likely to be made by employers and workers, the symptoms of shortages that are likely to be observed, the reasons why shortages might persist for extended periods, and the likely consequences of shortages.

The next four chapters provide the findings from our four case studies. For each occupation we describe the occupation, present the entry requirements and training paths for the occupation, and analyze employment and earnings trends for the occupation. We then analyze the evidence on the extent to which there appears to be a shortage for the occupation, the factors that contributed to the shortage, the consequences of the shortage, steps that have been taken to alleviate the shortage, and recommended policies that can be taken to further deal with the shortage. The final chapter synthesizes the results of the four case studies and, based on our research, provides conclusions and recommendations relating to the major objectives of this study.

CHAPTER 2

CAUSES AND CONSEQUENCES OF LABOR SHORTAGES

A. Introduction

It is important to address the causes and consequences of labor shortages before proceeding to the case studies for several reasons. First, because we have adopted a fairly broad definition of a shortage, we will have no single indicator that a shortage exists. Thus, in our case studies we look for evidence of the causes, adjustments, and consequences of shortages. The four occupations covered by the case studies were selected to provide significant variation in industry, skill levels, training, market regulation, and other factors. Thus, we can expect shortages to arise and manifest themselves differently in the various occupations.

By reviewing the economic theory of the causes and consequences of shortages prior to conducting the case studies, we will be aware of the appropriate market signals to look for in assessing whether or not a shortage exists. This is especially important because we anticipated (and found) that under certain conditions various interest groups have incentives to argue that a shortage is present or absent. For example, employers and trade associations sometimes have an incentive to claim that there is a shortage to increase immigration quotas for particular occupations, giving them access to a broader pool of applicants. At other times, employers might find it in their interest to claim there are no shortages in order to gain better leverage in contract negotiations with their workforce.

Another important reason for analyzing the causes and consequences of shortages is to help identify and assess potential public and private policies for dealing with shortages. Being able to identify causes will help interested parties focus on the relevant developments in labor and product markets. Understanding the consequences will help us to assess what interventions, if any, are appropriate by government, employers, and workers.

Before turning to the causes and consequences of labor shortages, it is useful to note some of the dimensions of shortages:

- **Geographic scope of the shortage.** Depending on the occupation and the nature of the market, labor markets can be national or regional in scope. Similarly, a particular occupation may have a nationwide shortage, or the shortage may be confined to a few labor markets or a single region of the country.

- **Longevity of the shortage.** As will be discussed below, various forces act to bring markets into and out of equilibrium. Thus, shortages can be relatively brief, lasting for a few weeks or months, or prolonged, lasting for one or more years.

- **Severity of the shortage.** Unlike the two dimensions discussed above, it is not easy to develop good measures of the severity of a shortage. Conceptually, we can measure the severity of a shortage in terms of the magnitude of the changes in wages required to restore equilibrium or in terms of the number of workers added to the occupation to alleviate the shortage. There are several difficulties with these concepts. First, we do not generally observe the supply and demand curves for specific occupations. Thus, we cannot directly estimate the size of the labor or wage gap of a shortage. Second, even if we could measure supply and demand, it would not be easy to classify a particular gap as large or small, especially when comparing across occupations -- occupations vary significantly in their normal vacancy rates and wage dispersion. Thus, a high vacancy rate for one occupation with a shortage may be characteristic of another occupation in equilibrium.

- **Sub-specialty shortages.** Up to this point we have considered occupations as if they are uniform. For some occupations this may be correct, but for others there may be differentiation by sub-specialty (e.g., emergency room nurses), years of work experience, or specialized training. In such cases, a shortage may exist for the entire occupation or only for workers with selected characteristics. For example, training for engineers has changed considerably over the past 20 years, and older electrical engineers may not be good substitutes for new engineers who have more training in designing integrated circuits. Likewise, new tool and die makers may not be good substitutes for experienced tool and die makers who have gained additional

> skills through their work. The key determinant of whether there can be shortages for some parts of an occupation is whether all workers within the occupation are reasonable substitutes for each other. If not, a shortage can exist within an occupation while other subcategories are in equilibrium or even in surplus.

For an occupation to have a shortage, two conditions are necessary. First, the occupation must be in disequilibrium, where the number of workers employers wish to hire exceeds the number willing to work at the prevailing wage. Second, the market must adjust slowly, if at all, with the achievement of equilibrium requiring a substantial period of time. We first discuss the reasons why markets are sometimes in disequilibrium. We then examine the adjustments that employers make to alleviate the disequilibrium, followed by a discussion of the reasons why disequilibria may persist. Lastly, we discuss the consequences of prolonged shortages. The chapter concludes with a discussion of the implications of the theory for the case studies.

B. Reasons Why Occupational Labor Markets Are in Disequilibrium

Labor shortages can result from a number of different causes. In this section we discuss the reasons why the labor market for a particular occupation might depart from an equilibrium situation.

1. Increase in the Demand for Labor

Exhibit 2.1 illustrates how a labor shortage can result from an increase in the demand for labor. Suppose that the labor market is initially in equilibrium at point E. If the demand for labor increases, the demand curve will shift to the right. If the supply curve remains the same and the prevailing price (wage) remains at W_E employers would like to hire Q_D workers, but only Q_E will be available. Thus, there will be a shortage of Q_D - Q_E workers.

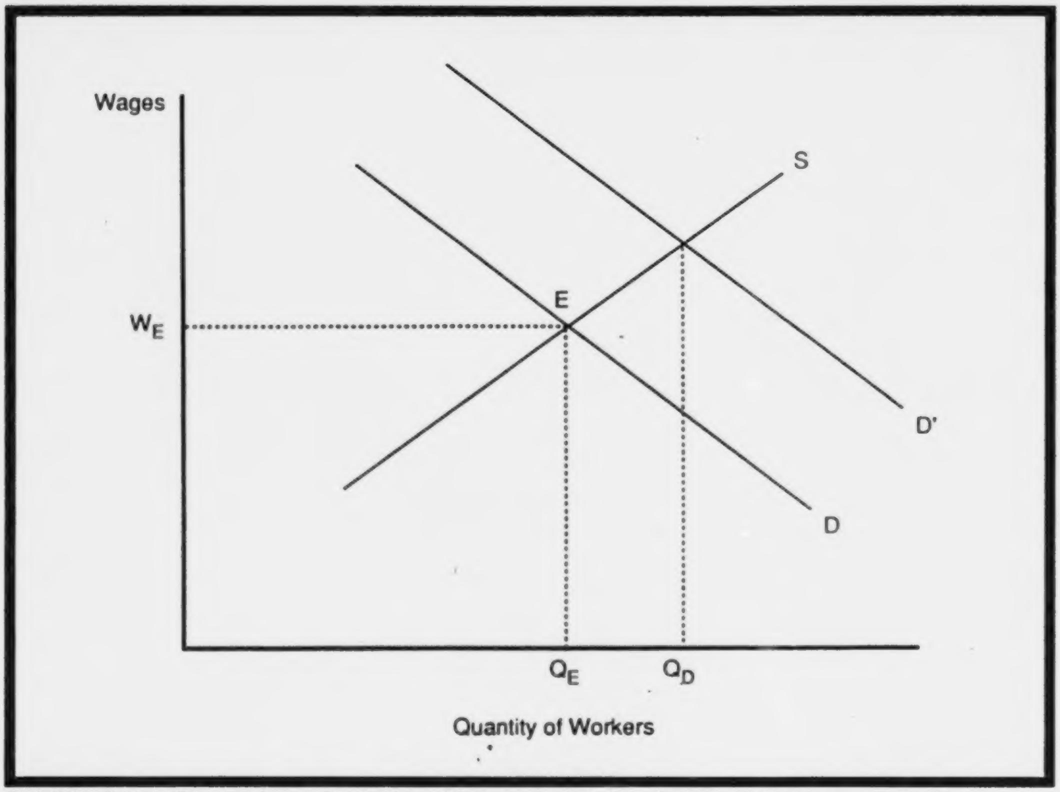

Exhibit 2.1: Illustration of a Labor Shortage Arising from an Increase in Labor Demand

The demand for labor by employers can increase for several reasons. Perhaps the most likely reason for an increase in the demand for labor is an increase in the demand for the goods or services produced by employers. An increase in the demand for the product can result from an increase in the number of consumers, an increase in the income or wealth of consumers, a change in the composition of the population of buyers, or changes in the tastes of consumers.

Another reason for an increase in the demand for labor is an increase in the prices of substitute factors of production. For example, in a hospital the demand for nurses might increase if the wage rates of doctors and/or nurse aides increase. The demand for a given type of labor will also increase if the price of a non-labor factor (e.g., raw materials or machinery) increases and the labor can be used as a substitute in the production process.

Both the Arrow-Capron and Blank-Stigler labor shortage models discussed in the previous chapter are demand-driven shortage models. The Arrow-Capron dynamic model is somewhat more complex because it deals with a situation where demand continually grows more rapidly than supply.

An increase in demand for labor in a particular occupation does not necessarily lead to a shortage. If the supply of labor to an occupation can respond to the increased demand, the result will be a new equilibrium with more workers employed and a higher wage rate than at the previous equilibrium, as is illustrated in Exhibit 2.1. An increase in demand will almost certainly require some time for the market to reach a new equilibrium, but if vacancies persist for a sustained period, the occupation can be characterized as experiencing a shortage. Reasons why occupational labor markets may adjust slowly are discussed in Section D of this chapter.

2. Decrease in the Supply of Labor

A decrease in the supply of labor to a particular market can also create a labor shortage. This situation is illustrated in Exhibit 2.2. Once again suppose that the market is originally in equilibrium at point E. If the labor supply curve is shifted to the left, indicating fewer workers available at each wage rate, there will be a labor shortage if the prevailing wage remains at W_E. Employers will still be trying to hire Q_E workers, but only Q_S workers will be available after the supply decreases. Thus, there will be a shortage of Q_E - Q_S workers.

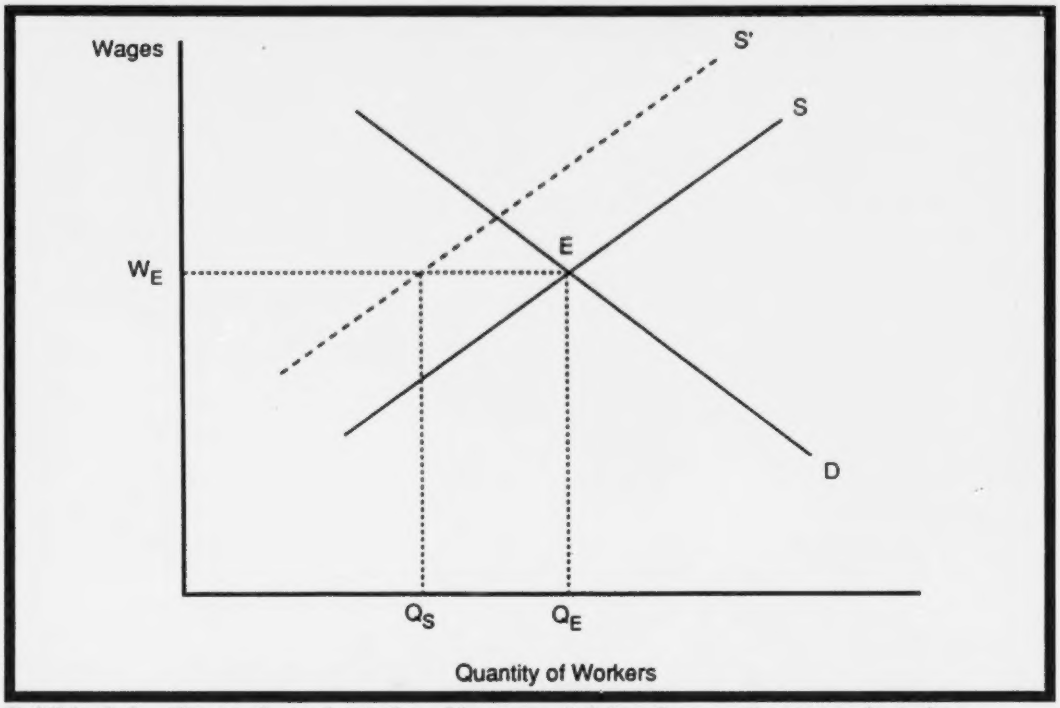

Exhibit 2.2: Illustration of a Labor Shortage Arising from a Decrease in Labor Supply

The labor supply curve for the labor market in question might shift for several reasons. One potential cause is a decrease in the size of the population that works in the relevant jobs. For example, as the baby boom generation has aged, employers who generally hire youth as they complete high school have suddenly faced a much smaller supply of entry-level workers from the so-called "baby-bust" generation, whose population is much smaller.

The supply curve might also shift to the left because wages in other occupations have risen, making employment in the market of interest less attractive, or because non-work opportunities, such as welfare, crime, and retirement, have become more attractive. Finally, the labor supply curve for an occupation might shift to the left because of restrictions on entry into the relevant labor market. Such restrictions may be implemented by the government (through licensing requirements and restricting the number of licenses granted), by professional organizations that set standards for practice, by labor unions, or by training institutions (e.g., universities, community colleges).

3. Restrictions on Prices

Although most prices are determined competitively by the market in the United States, in some industries the price of labor or the price of the final product is regulated. For example, cities generally regulate the price that taxi drivers can charge. In such instances, the supply curve is truncated at the regulated price. This situation is illustrated in Exhibit 2.3. The wage rate is restricted to be no higher than W_M so the supply curve at higher wages is indicated by a dashed line. The labor that will be supplied at that wage is

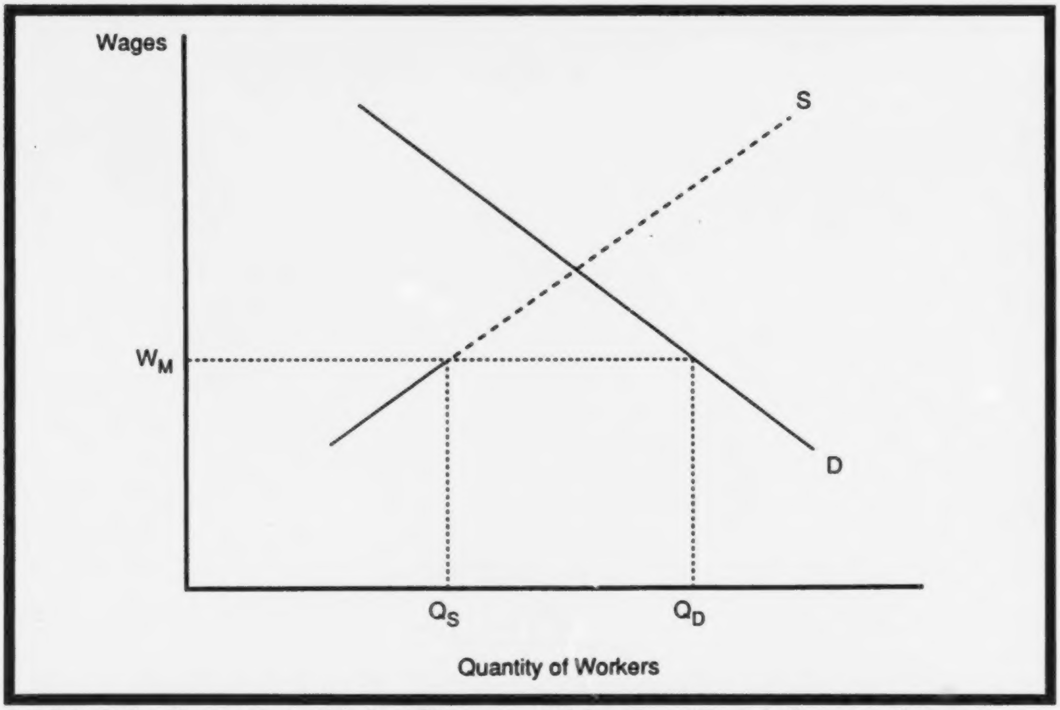

Exhibit 2.3: Illustration of Labor Shortage Arising from Restrictions on Wages

Q_S. At that wage, however, the demand is for Q_D workers, so there is a shortage of Q_D - Q_S workers. An example of this type of shortage is the federal government's market for entry-level Ph.D. economists. The federal government traditionally hires entry-level economists at the GS-12 level, and agencies are generally not permitted to pay a higher wage rate. The current market wage for entry-level economists is higher, so in many government agencies there is a shortage of entry-level Ph.D. economists.

More commonly, the government regulates the prices of products and services rather than labor. In industries where labor comprises a relatively small share of the product's price, such as in the generation of electric power, the product price regulation is not likely to cause a labor shortage. In very labor-intensive industries, however, output price regulation can be tantamount to regulating the price of labor. Examples include the health care industry in general and the home care industry in particular. A large share of the health industry is financed by the Medicare and Medicaid programs. In the case of Medicare, the federal government limits the reimbursements that providers can obtain for treating covered elderly patients. State governments provide similar regulation under Medicaid programs for the poor. By restricting the charges that providers can make, the providers face limits on what they can pay workers and still cover their costs.

C. Adjustments to Occupational Shortages by Employers

This section describes some of the actions that firms are likely to take to deal with labor imbalances. Because employers will note the problems first, as they are unable to fill vacancies at current wage rates, employers will take actions to deal with the unfilled positions. Some actions are more costly than others, so employers should undertake the least expensive and most easily reversed actions first. The potential actions that employers can take are listed roughly in order of desirability from the employer's point of view. In particular cases, of course, some of the potential actions may be inapplicable or employers may undertake the actions in a different order. Note that all the potential actions employers can take are the opposite of the actions that lead to vacancies: increasing supply, decreasing demand, and increasing wages. Finally, many of the actions described below may be undertaken by employers for reasons other than trying to fill vacant positions.

1. Increase Recruiting Efforts

A logical first step to fill vacancies is to increase recruiting efforts. Although employers will incur short-term costs in expanding recruiting, there are no long-term or permanent costs involved. Recruiting can be increased through several approaches:

- **Increased advertising in the usual outlets.** For example, employers who advertise in newspapers can increase the frequency of the advertisements or the size of the advertisements to attract more attention to vacancies.

- **Advertise in other media.** To reach a wider audience of potential employees, firms can expand their advertising campaigns. Firms that traditionally recruited through newspaper advertisements can add other newspapers in the community, radio, and television. Use of job fairs is another such technique.

- **Expand the recruiting area.** Employers who believe that the problem is local rather than regional or national can increase the geographical scope of their recruiting efforts. For example, a firm having difficulty recruiting machinists in Chicago might expand its recruiting efforts to nearby Milwaukee. Some occupations, generally those with highly skilled jobs, already have national labor markets. For these firms, and for firms recruiting for occupations with a national shortage, the only way to increase the recruiting market is to recruit abroad.

- **Use public and private employment agencies.** Firms that do not already do so can make use of public and private employment agencies. Public agencies, referred to as the Employment Service or Job Service, are free to both workers and employers. In some states the Employment Service may tend to specialize in serving particular types of workers, but all employers can list their openings with the Employment Service. Private employment agencies charge a fee to either the worker or the firm, with the fee based either on the time spent by the agency or as a percentage of the hired worker's salary.

- **Pay recruiting bonuses to employees who bring in new workers.** For many employers, current workers are often the best source of potential new hires. Employees are likely to be hesitant to recommend individuals who are unqualified, and the candidates they recommend are likely to know more about the work and working conditions than other job candidates. Thus, for many firms current employees are a major source of job applicants. To encourage workers to assist in the recruiting process, employers sometimes offer a bonus for referring qualified applicants or applicants who are hired.

2. Increase Use of Overtime

A relatively simple solution to the problem of filling vacancies is to have current employees work more hours. Employers who anticipate that the problem will not last for a substantial period of time are likely to use this approach. If the workers are exempt from the overtime provisions of the Fair Labor Standards Act (FLSA) and do not receive a premium for hours in excess of 40 hours per week, overtime may actually save money relative to hiring additional workers. This is because many fringe benefits, such as health insurance, unemployment insurance, and workers compensation, are fixed and the firm will not experience any increase in costs for these benefits when current employees work additional hours.

As a long-term measure, however, increased use of overtime may not be a viable option. For workers not exempt from the FLSA, the employer must pay a premium of at least 50 percent for overtime work, which gives employers a strong financial incentive to try other means to deal with vacancy problems. In addition, many workers prefer not to work overtime, so increased use of overtime may lead to employee dissatisfaction and increased turnover, thereby exacerbating the vacancy problem instead of reducing it.

3. Reduce Minimum Qualifications for the Job

Another method of filling vacancies is to reduce the minimum hiring standards for the occupation. At first this may appear damaging, but this is not necessarily the case. The firm may have set the minimum hiring qualifications higher than necessary when labor was abundant. For example, a firm may have required a college degree for sales workers when a high school diploma would have been adequate. For professional jobs, the firm may have selected graduates from the most prestigious schools, or have had a minimum grade point average or test score cutoff.

If the productivity of less qualified workers is lower, the firm may be able to train the workers to reach the productivity levels of the more qualified workers after a reasonable period of time. When a firm reduces the minimum hiring qualifications, it may be able to reduce the wages offered or at least avoid increasing wages.

4. Restructure Work to Use Current or New Employees in Other Occupations

If employers have difficulty filling vacancies with workers in one occupation, it is sometimes possible to restructure the work to make use of workers in other occupations. For example, in a hospital services are performed by workers in a number of occupations, e.g., physicians, nurses, nurse aides, and orderlies. Although some duties cannot be readily reassigned (only physicians can make diagnoses), nurses can perform some of the testing, and care-taking functions can be assumed by virtually any of the staff. Likewise, some engineering tasks can be performed by drafters, and some tasks performed by teachers can be performed by aides.

For several reasons, firms will not always make use of this option. For example, hospitals are unlikely to use physicians to perform care-taking tasks because physicians are so costly that other measures will generally be less expensive. In addition, assigning what is perceived to be low-level work to employees may hurt morale and productivity. Finally, reassigning tasks may involve considerable expense and disruption because of training and rescheduling that must be conducted.

In some cases, complex jobs can be organized into simpler tasks that can be handled by less skilled workers. For example, a tool and die maker's work could be split among metal workers who possess some, but not all, of the skills of a tool and die maker. In general, shortages are more likely to occur for high-skill occupations than low-skill occupations.[1]

5. Substitute Machinery and Equipment for Labor

Employers can sometimes alter the production process to replace workers with equipment. As technology has advanced in recent years, the types of tasks performed by machines have also changed. Formerly, machines typically replaced humans in unskilled tasks such as lifting and moving. More recently, computer-based technology permits machines to perform more sophisticated tasks including voice recognition, drawing, designing, and (to some extent) teaching. Artificial intelligence "expert system" models even permit computers to substitute for professional judgment under certain circumstances.

There are obviously limits to how much technology can substitute for labor, and in many situations technology will be used to substitute for labor for reasons other than difficulty in filling job openings. However, substituting technology for labor is sometimes a viable method of dealing with difficulty in filling vacancies.

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[1] Other factors can also contribute to changes in the mix of skill levels desired by employers. There is currently debate over whether computers and other microchip applications have led to "up-skilling" or "de-skilling" of jobs.

6. Train Workers for the Jobs

For some occupations, training is traditionally performed by employers, either formally through apprenticeship or other training programs, or informally through on-the-job training. For many other occupations, however, training for entry-level jobs is performed by other means -- typically colleges and universities for professional occupations, and vocational schools and trade schools for skilled craft and service occupations. Employers who traditionally do not train their own workers may resort to offering or sponsoring training if they are experiencing difficulty filling vacancies.

Offering training for an occupation is often a major commitment for employers, and it is typically not provided unless most other approaches fail. There are several related reasons why firms are reluctant to offer occupational training. First, the training is generally time consuming. Training new employees for a skilled occupation can sometimes take years, and by the time the workers are trained, the problem of filling vacancies may have disappeared. Second, establishing and operating a training program to bring new employees into an occupation is costly. Employers must feel confident that they can recoup their investment before they are willing to underwrite these costs. Finally, training new hires for occupations with vacancies carries several risks for employers. The individuals selected may not be able to successfully complete the training, or if the skills are transferable to other employers, they may quit shortly after they are trained.[2]

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[2] The arguments presented above apply primarily to training new hires for entry into a new occupation. The arguments do not apply, or do not apply to the same extent, to (continued...)

For occupations that do not require a college degree, establishing an apprenticeship program is one potential method of training workers for occupations through a combination of classroom and on-the-job training. The Department of Labor has recently moved to expand apprenticeship opportunities through its Apprenticeship 2000 program. Other possibilities include training current or new workers in-house or in cooperation with local colleges, vocational schools, and proprietary schools. In some cases the employer may not pay for the training -- the courses can be partially or fully funded under federal programs (primarily the Job Training Partnership Act [JTPA]), state training programs, or educational institutions.

Training for entry into an occupation can be illustrated by an extreme but interesting case. The uniformed services need physicians, but they are prohibited from paying market wages to physicians (a shortage induced by market restrictions). To get around this problem, the uniformed services established their own medical school to train physicians at no cost to the students. To prevent the students from leaving soon after being trained, the students are required to sign contracts agreeing to stay in the military for a specified number of years.

7. Improve Working Conditions

Improving working conditions sometimes is an effective way to attract new workers and/or reduce turnover. Working conditions include factors such as hours

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[2] (...continued)
training workers already on the payroll to improve their skills. Moreover, even if training does not pay for an individual employer, it might pay for society as a whole. See Burt S. Barnow, Amy B. Chasanov, and Abhay Pande (April 1990). Financial Incentives for Employer-Provided Training: A Review of Relevant Experience in the United States and Abroad. Washington, D.C.: Urban Institute Policy Memorandum prepared for the U.S. Department of Labor.

worked, upgrades in equipment and facilities used by workers, level and type of supervision, involvement in operation of the firm, training to deal with stress related to the job, and recognition of the importance of workers in the occupation. Improvements in working conditions can be especially useful in situations where vacancies are created by high turnover. High turnover is often associated with occupations with high stress, low wages, or low prestige. A concomitant benefit of improving working conditions is that productivity may increase as well.

Improving the number or timing of work hours can also help in recruiting and/or reducing vacancies. Some occupations may require split shifts (e.g., driving buses), night and weekend work (e.g., health occupations), or downtime between productive periods (e.g., home care). Employers sometimes deal with these unpleasant working conditions by offering premiums for work at undesirable times, but they often believe they cannot afford a sufficiently high shift differential to eliminate the problem. Although shift differentials are still often necessary for undesirable shifts, employers can sometimes improve recruiting and reduce turnover by working with employees to structure shifts to be as desirable as feasible. For example, hospitals have experimented with a number of shift structures to fill the most undesirable shifts. In the home care industry, where workers sometimes have a great deal of travel time and down time between cases, some employers have been successful in restructuring caseloads to minimize these problems.

8. Offer Bonuses to New Employees

Although this approach is not commonly used, firms sometimes offer new employees bonuses for joining the firm. Signing bonuses are similar to paying current employees bonuses (or "bounties") for recruiting new employees for occupations that are difficult to fill, except that bonuses go to the new employees rather than the current employees.

For workers, this option provides an extra incentive to join the firm offering the bonuses. This approach is more advantageous for employers than raising wages because it is a one-time cost and only affects the employees added in the occupation of interest. The disadvantage for employers is that the employees lured by such bonuses may not be as interested in long-term careers with the firm, and they may be "pirated" away by other firms offering similar bonuses. Signing bonuses are most frequently used when employers feel that they are under intense pressure to fill vacancies in the short run. They have been used by hospitals to recruit nurses and by data processing firms to recruit programmers. When employers recognize this to be the case, they sometimes resort to using hiring bonuses to lure employees from other firms.

9. Improve Wages and Fringe Benefits

Increasing wages and/or fringe benefits would, at first glance, appear to be the logical way for a firm to attract more workers into an occupation. Based on the simple supply and demand curve analysis, increasing wages is an obvious way to increase the number of workers willing to work in a particular occupation. Employers are generally reluctant to increase wages for several reasons. First, an increase in wages will affect the entire workforce in the occupation with vacancies, not just the new workers the firm wishes to attract. Thus, the employer incurs costs for more than just the added workers. Second, the employer might have to increase wages for workers in other occupations as well. Employers generally attempt to maintain equity among workers in various occupations. Thus, if an employer increases wages for one occupation because of difficulties in filling vacancies, wages may have to be increased for other occupations as well to maintain what are viewed as appropriate differentials. Another problem with raising wages is that wages tend to be "sticky" in terms of moving down. That is, once market conditions change, employers will generally have less flexibility to reduce wages later. Finally, raising wages might not be an effective means of recruiting in the short run if supply is not responsive to changes in wages (i.e., the supply is inelastic). In the extreme case, if the supply is totally fixed in the short run, higher wages cannot induce any change in the number of workers qualified to work in the occupation.

Improving fringe benefits is similar to increasing wages, but in some instances employers will reduce their vacancy rates more by improving benefits rather than increasing wages by a similar amount. For example, health insurance is often an important fringe benefit to provide. Because group health insurance rates are usually substantially less expensive than individual policies, the value of health insurance to the employee will often be greater than the cost to the employer. Health insurance is especially a concern for employers trying to fill vacancies for relatively low-paying jobs if Aid to Families with Dependent Children (AFDC) recipients are potential workers. This is because AFDC recipients receive excellent health insurance through the Medicaid program, and they are often hesitant to take jobs if they will lose coverage for themselves and their children.[3] Unfortunately, many employers who do not provide health insurance are small and pay low wages. Thus, adding benefits such as health insurance may be most burdensome in those cases where it would be most important.

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[3] The Family Support Act of 1988 partially alleviates this problem by providing transitional Medicaid benefits for up to one year for AFDC recipients who leave the program to take employment. Some AFDC recipients may still be reluctant to leave AFDC if their employer does not provide health insurance, or they may quit to regain Medicaid coverage later if they or their children require health care.

10. Contract Out the Work

If a firm is unable to hire all the employees it needs in particular occupations, the firm may be able to contract out the work to another employer who is not experiencing the problems. In some instances the labor problem may be regional in nature, and the firm can contract out the work to a firm in another part of the country. If the problem is nationwide, the firm can sometimes have the work performed overseas.

11. Turn Down Work

If a firm has exhausted all means that it considers reasonable and can find no reasonable way around its occupational vacancies, the firm always has the option of turning down work. Employers generally use this "solution" only as a last resort because they do not like to give up customers to competitors and, more basically, the only way to make a profit is to sell goods and services.

If the firm has limited capacity to conduct its business because of occupational shortages, there are more subtle measures than simply refusing work. For example, the firm might reduce its marketing activity, and thus reduce the demand for its products.

D. Reasons Labor Markets May Adjust Slowly

As discussed above, labor markets, and other markets as well, constantly experience changes in supply and demand that cause them to deviate from an equilibrium situation. In most cases, firms and workers will take actions that will move the labor market toward equilibrium. In some instances, however, the market adjusts slowly, and equilibrium is not restored, resulting in a shortage for the occupation. The literature suggests several factors that may result in the market failing to clear reasonably quickly. These factors are discussed below.

1. Slow Reaction Time by Employers

In most industries, each individual firm employs a small share of the workers in a particular occupation. Thus, individual employers may be unaware of an increase in demand, and they are almost certainly unaware of the magnitude of the increase. As the firm recognizes that workers cannot be attracted at what they believe to be the market wage, they may then take the actions described in Section C to deal with the vacancies.

A number of factors can influence the reaction time of employers. If the firm does not recruit frequently for the occupation, either because of low turnover or because it employs few workers in the occupation, the firm may not know what the typical period is for filling vacancies for that occupation. The firm also may not have a good idea of what the market wage is, and thus may tend to set its offer wage too low.

Several institutional factors are likely to affect reaction time by employers. Occupations characterized by long periods of vacancies are more likely to have slow reaction times by employers because employers expect to take a significant amount of time before they fill vacancies. Lengthy recruiting periods are more characteristic of occupations with high salaries, typically professional and managerial occupations and highly skilled craft jobs. Occupations where employment is concentrated in small firms are likely to be characterized by slow reaction times because the employers are likely to recruit for fewer positions and less frequently than larger employers.

Other institutional factors that can influence employer reaction time include the extent to which employers and workers in the occupation are organized and exchange information. For example if employers have a trade association that monitors and publishes data on wages, vacancies, and other employment-related factors, employers will be aware of the occupational situation early in the search process. Of course, receiving national-level data is not as useful as local data for an employer who recruits locally. For some occupations, hiring is done in conjunction with the trade union representing the workers. Even if most firms are small, the centralization of the hiring process will help employers gain a quicker grasp of the supply available.

2. Slow Response Time by Employers

After firms recognize that there is excess demand for an occupation, they may delay taking actions to fill their vacancies. Most strategies that a firm might try could be risky, expensive, or both. Relatively minor responses, such as intensifying the recruiting effort, will waste the firm's money if the positions would be filled without them. More significant responses, such as changing the occupational structure of the firm and training workers, require major commitments to plan and implement. Such actions are unlikely to be taken unless the employer believes that the firm is facing a prolonged period of difficulty in hiring.

Increasing wages can also be a major step for employers. As noted above, the wage increases must also be passed on to current workers as well as the newly hired workers, and sometimes workers in other occupations must receive increases as well. If the firm is in a competitive product market, it must carefully balance two competing interests. If it sets the wage too high, the firm's costs will be higher than the costs of its competitors, and the firm is likely to either lose market share (if it passes the costs on to consumers) or profits (if it absorbs the increased costs) or both. Thus, firms are likely to be conservative in increasing wages as a method of filling vacancies.

3. Slow Reaction Time by Workers

Workers in other occupations and individuals who are unemployed or out of the labor force may not immediately recognize that wages and\or working conditions have improved in the occupation with the developing shortage. If workers who might be attracted to jobs in the occupation with the excess demand are unaware of the opportunities, they will not be able to consider entering that occupation. The time required for workers to become aware of the new opportunities depends on how effective firms' recruiting strategies are and how sensitive workers are to the recruiting effort.

4. Slow Response Time by Workers

Once workers are aware of the opportunities, their response time will depend on the time required to qualify for the positions and the costs and benefits of obtaining any needed qualifications, applying for the positions, and changing jobs. Typically, the greater are the incentives provided by employers to induce workers into the occupation of interest, the quicker and greater will be the response by potential entrants.

For many occupations, training time is the most important factor slowing worker response time. Occupations requiring a specialized college degree, such as engineering, will be very slow in adjusting because the "pipeline" for producing new engineers is four years. The lag might be more extensive if some potential engineers must adjust their mathematics course load in high school. Some specialized occupations, such as architecture and medicine, require even longer preparation.

Many occupations requiring less than a college education still demand several years of training and will have a substantial lag before interested individuals qualify for the occupation. For example, many technician and skilled craft positions take two or more years of training. At the other extreme, some low-skill jobs, including paraprofessional home health care workers, may require as little as one week of formal training. Thus, the worker response lag generally will be shorter.

Response time can also be slowed if training institutions lack the capacity to train additional workers. For instance, the supply of nurses cannot be readily expanded if there are too few nursing instructors.

5. Restrictions on Occupational Entry

In some cases institutional barriers to occupational entry will slow down the adjustment process. These restrictions are generally instituted to achieve certain purposes, so removing or modifying the barriers is not always appropriate. However, in times of occupational shortages, consideration is often given to modifying these restrictions.

One example of a barrier to occupational entry is limits in the enrollment capacity of training institutions that supply workers for the occupation. Suppose, for instance, that hospitals needed to hire more physicians and there were enough individuals interested in attending medical school to meet the hospitals' demands. If the nation's medical schools could not admit the extra students because of limited capacity, the supply of physicians could not increase. Note that hospitals do not regulate the capacity of medical schools, so it would be difficult for this market to adjust.

Other institutional barriers include licensing and certification requirements. Employers might be willing to lower the standards for a particular occupation, but if entry to the occupation is regulated, the regulatory or licensing board would have to agree. These boards, which are often state bodies, might not wish to lower the standards, and current members of the occupation might object to relaxation because it would cheapen their credentials and possibly result in lower wages. Restrictions on immigration may operate as a similar institutional barrier to achieving equilibrium in occupational labor markets. Trade unions or associations, at the time of contract negotiations or through other activities, may restrict the supply of workers or hiring requirements for workers. An example of this type of barrier is restrictions on the ratio of apprentices to journey workers in an occupation. In some instances such restrictions could constrain employers and potential entrants from increasing the number of entrants in an occupation making use of apprenticeships.

All of the barriers mentioned above were established for particular reasons, usually to assure quality for workers in the occupation. Although consideration should be given to changing or eliminating the barriers, their original intent should not be forgotten.

6. Continuous Increases in Labor Demand

If the labor demand schedule continuously increases faster than the amount supplied can increase, then the market will not achieve equilibrium. This scenario is the basis of the Arrow-Capron dynamic model of labor shortages, and it can occur in periods of rapid sustained growth in one or more industries that employ workers in the shortage occupation. Such a period of sustained rapid growth for a particular sector of the economy can prevent the market from clearing for a substantial period of time. According to Arrow and Capron, this situation occurred for engineers following World War II. Note that in this situation the problem is not necessarily that workers or employers cannot adjust; rather, the problem is due to continued shocks to the equilibrium levels of employment and wages.

E. Consequences of Labor Shortages

Labor shortages can lead to a number of consequences for the firms experiencing the shortages, and the rest of the economy as well. In economic terms, the major consequence of a sustained shortage is that the economy will be operating less efficiently than it could. Until the market achieves equilibrium, resources are not put to their most productive use. Thus, aggregate production for the nation is below capacity. Workers may have to work more hours than they desire, or they may be assigned to jobs they do not want. Employers may have to use their workers and equipment less efficiently than they desire, and this may result in lower output and reduced profits. Consumers will be denied the goods and services they wish to buy. In some cases, the impact on consumers will be relatively modest, but if consumers cannot obtain needed health care because of a labor shortage, the consequences can be severe. Finally, the impact of a shortage can extend beyond the firms directly experiencing the problem. A shortage of home health workers or nursing home workers, for example, may result in hospitals having to keep patients longer than is desirable. A shortage of workers who produce tires would result in problems for the automobile industry as well. Thus, it is difficult to trace all of the effects of an occupational shortage. In the case studies that follow we indicate the impacts of shortages in the occupations studied for the economy as a whole as well as for the employers experiencing the shortages.

F. Implications for the Case Studies

In this chapter we have presented a framework to analyze the causes of occupational imbalances, the types of adjustments that we anticipate employers and workers to make, the reasons why these adjustments might not ameliorate the shortages, and the consequences of shortages. In the case studies presented in the following chapters, we analyze four occupations believed to have experienced labor shortages. Because vacancy data are not available, we have relied on other published data and interviews with employers, trade associations, unions, government officials, and researchers to analyze the occupations.

Available published data are often useful for examining objective factors of interest such as changes in wage rates and employment levels for the occupations of interest relative to other occupations. However, published data do not adequately address the issues of why the shortage arose, what types of adjustments were made, and why the market did not reach equilibrium quickly. For a better understanding of these issues, we have relied heavily on the detailed interviews. Because shortages can vary in their scope and intensity, because there is a lack of data on vacancies, and because there are no simple quantitative indicators of when a shortage exists, the results presented in the four case studies do not present precise measures of the magnitudes of the shortages. However, we believe that the case studies will help shed light on this important is:

CHAPTER 3

CASE STUDY OF SPECIAL EDUCATION TEACHERS

A. Description of the Occupation

Special education teachers work with students who face special emotional, developmental, and physical challenges. The special needs and abilities of these students, who may be emotionally disturbed, learning disabled, mentally retarded, or have speech, hearing, vision, or other impairments, cannot be met by conventional teaching practices. Special education teachers use a variety of classroom methods to tailor their material to the varying learning characteristics and needs of their students, usually providing instruction to small groups or individuals.

In addition to providing educational instruction, special education teachers have several other responsibilities. First, they are involved in the identification of exceptional children[1] and with the transition of these students between special education and mainstream classes. To this end, they also act as consultants to the entire faculty on issues regarding the transition of exceptional children back into conventional classroom settings, a process referred to as "mainstreaming." Second, they serve as advisors to parents of exceptional children, advising them on the motivational, cognitive, and social consequences of their children's conditions. Finally, they formulate and evaluate long-term strategies to help their students attain a sense of social and personal self-sufficiency. Often the special education teacher may work in a resource room, a place where students with mild handicaps spend less than 50 percent of the school day working towards specified goals.

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[1] The terms "exceptional" and "challenged" have replaced terms such as "disabled" or "handicapped" in much of the special education literature. Except when otherwise noted, these terms should be considered synonymous.

Study of the labor market for this profession is interesting for several reasons. Although special education teachers are usually paid according to the same wage scale as all other teachers, special education teachers have higher rates of attrition, longer and more rigorous training and certification requirements, and a greater number of administrative and legislative burdens.

The history of special education teaching as a distinct area of teaching is quite brief, beginning in the late 1950s. Special education teachers prior to that time watered down or simplified regular classroom curricula, an approach which largely reflected the lack of empirical knowledge in the field as well as a lack of recognition that a different approach was required for the education of children with handicaps. In the case of severely handicapped students, who were often placed in separate centers or institutions and thus separated from their mainstream peers, teachers for the most part focused on controlling student behavior and attempting to teach students as best they could using conventional instructional methods.[2]

In view of the lack of specialized personnel to train special education teachers, PL 85-926 was passed by Congress in 1958 to establish university doctoral-level training programs in the area of mental retardation. This legislation, in conjunction with the economic prosperity of the following 15 years, contributed to a proliferation of educational programs for exceptional children.[3] The next major steps, in the early 1970s, were the passage of PL 93-112, the Vocational Rehabilitation Act, which mandated the education and civil rights of all handicapped children and youth, and PL 94-142, the Education for All Handicapped Children Act (EHA), which guaranteed a "free and appropriate" education to all handicapped children between the ages of 3 and 21. These acts affected more than eight million children and greatly increased the demand for special education personnel; in addition, they gave the field an intellectual and professional legitimacy it had not previously enjoyed.[4]

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[2] Douglas J. Palmer and Robert Hall (1987). "Special Education, Teacher Training." In Encyclopedia of Special Education, eds. Cecil Reynolds and Lester Mann. New York: Wiley and Co., p. 1478.

[3] Palmer and Hall (1987), p. 1478.

The EHA mandate had several other consequences. First, it stimulated research in the instructional, psychological, and social aspects of special education. Second, it hastened the accumulation and dissemination of new educational methods developed in schools. Finally, it placed the special education teacher at the center of a network of supporting special education personnel (e.g., psychologists, therapists, and aides), all with the goal of providing an "appropriate" education to exceptional children.

There are several professions closely related to special education teaching, such as occupational and physical therapists, special education psychologists, and mainstream teachers. The nature of the work special education teachers perform most closely resembles that of mainstream teachers; it is therefore with mainstream teaching that we will most often compare special education teaching.

B. Training and Recruitment of Special Education Teachers

This section discusses the educational requirements and qualifications for entry into special education teaching, the factors affecting these requirements, and the methods employers use to fill vacancies in the field. This examination of the means by which individuals enter the occupation will lay the groundwork for the analysis of shortages discussed later in the chapter.

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[4] Edward L. Sattler and Joan L. Sattler (1985). "Economic Realities of Special Education." Teacher Education and Special Education. 8(2), p. 98.

1. Educational Qualifications and Entry Requirements

a. Current Requirements

In a field with such varied responsibilities and teaching goals, the requirements to enter special education are not universally agreed upon and are in constant flux. As the goals of special education progressed in the 1960s and 1970s from mere behavior control and remedial education to also include emotional and developmental therapy, the proficiencies and skills necessary for a special education teacher expanded beyond those required for mainstream teachers.[5]

Entry into special education teaching is primarily regulated by state certification. Not unlike those for general education, the requirements for certification reflect each state's educational philosophy regarding the education of exceptional children, and more recently, have reflected the severity of the shortage of qualified special education teachers. As might be expected, there is great variation in state special education certification standards, largely because no clear consensus exists regarding the formal skills and knowledge special education teachers ought to have.[6]

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[5] The Education for All Handicapped Children Act guarantees a "free and appropriate" education for all exceptional children, and it encourages teachers to document and report the children's progress. In practical terms, this call for accountability on the part of teachers hastened the shift to replace the generalized curricula of the 1950s and 1960s with curricula matched to the abilities and needs of the students.

[6] Geraldine D. Chapey, Irene S. Pyszkowski, and Teresa A. Trimarco (1985). "National Trends for Certification and Training of Special Education Teachers." Teacher Education
(continued...)

Most states base their certification processes on a few broad premises. First, special education teachers must have a firm foundation in general literacy, humanities, liberal arts, and the sciences. Second, they must be qualified in general education as well as in special education; this includes knowledge of basic academic skills, curricula, instructional methods, and behavioral management strategies.[7] Third, special education teachers must be able to function as team members and consultants, providing expertise to the general teaching faculty and parents regarding the child's handicapping condition. And finally, special education teachers must be able to assess a pupil's level of functioning and select, implement, and evaluate instructional programs based on each student's individual learning abilities.

Most state certification requirements reflect these fundamental premises. They require a bachelor's degree in education, and although the degree need not be in special education, it would optimally include some course work in special education. In addition, some states require graduate work in special education teaching. The length and scope of this work varies, but a master's degree in special education is often required or suggested in certain specialties.[8] In addition to (or in conjunction with) graduate work, most states require approximately one year of paid internship training in a chosen special education category; this is based on the recognition that supervised practical experience is important

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and Special Education. 8(4), p. 207. This issue was also raised in a number of interviews with researchers and officials in special education.

[7] Palmer and Hall (1987), p. 1479. As used here, the term "certification" implies full certification; other types, such as temporary, emergency, and provisional certification, are discussed later.

[8] Graduate special education includes course work related to testing and measurement, educational statistics, and consultative and directed teaching in elementary and special education (Palmer and Hall (1987), p. 1479).

in the formation of good instructional skills and habits.[9] According to several researchers whom we interviewed, a large number of states require "dual certification" in special education, meaning that special education teachers are required to obtain a general teaching certificate in order to qualify for certification in special education.[10] Finally, a majority of states (45 in 1987) also require a teacher competency test such as the National Teachers Examination (NTE) as part of the process of initially certifying all teachers.[11] [12]

A major characteristic of special education certification is the specific category in which it is granted. States may certify special education teachers based upon specific handicap-based categories (categorical certification), or they may certify teachers without strictly defining the areas of special education in which they are qualified to teach (non-categorical and multicategorical certification).[13] Rather than dividing certification according to handicap classifications, the noncategorial and multicategorical approaches often specify certification by the level of education (e.g., K-9, 9-12, etc.) or severity of handicap (e.g., mild, moderate, severe) at which teachers are qualified to teach.

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[9] Palmer and Hall (1987), p. 1479.

[10] As might be expected, dual certification has important consequences for the supply of special education teachers; first, it extends the investment in time and training required for special education certification; and second, it influences their possible career paths, allowing them to enter general education easily and immediately. The relevance of these two factors to labor shortages in the occupation is discussed later in the chapter.

[11] Roberta Strosnider and Linda F. Little (1988). "Special Education as a Profession: A Proposal for National Certification Standards." Teacher Education and Special Education. 11(4), p. 169.

[12] J.D. Stern. The Condition of Education: Elementary and Secondary Education, 1988, Volume 1. Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, pp. 70-71, 129-130.

[13] Categorical certification, the more traditional approach, is based on the handicap by which the pupils are classified. Certificates of this type include those for the learning disabled, mentally retarded, hearing impaired, speech impaired, and physically handicapped. The less traditional and more generic policy includes noncategorical certification and multicategorical certification. The former, noncategorical, refers to certification in programs teaching a range of mildly handicapped children, from those with (continued...)

Each of these educational philosophies has its advantages: the former approach allows specialization in a particular handicap and a better understanding of the skills and needs of children with those handicaps; the latter and more generic approach offers more flexibility for special education teachers, allowing them to teach children with different types of handicaps, as well as allowing for a broader approach to teaching exceptional children which doesn't rigidly classify them. Approximately half of all the states (24) currently consider their certification to be noncategorical; however, a majority of these states also issue certificates in specific categories, such as deafness/hearing impaired, blind/visually impaired, and emotionally disturbed. The remaining states provide only categorical certification.[14]

In 1988, over 180 different category titles were used by states, with most states defining categories differently and dividing special education into different numbers of categories. The U.S. Department of Education, in collecting its data on special education programs, collapses this diverse group into 10 broad categories:

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[13](...continued)
mild to moderate learning disabilities and behavior problems; it is based on the belief that traditional classification schemes are not important for instructional purposes; the latter, and less common, multicategorical certification is for programs in which children of more diverse categories and various levels of severity are enrolled in a single program. See Edward A. Blackhurst, Deborah A. Bott, and Donald P. Cross (1987). "Noncategorical Special Education Personnel Preparation." In Handbook of Special Education: Research and Practice, Vol. 1., eds. Margaret C. Wang, Maynard Reynolds, and Herbert Walberg. New York: Pergamen Press, p. 313.

[14] Terry R. Berkeley (1990). "Special Education Certification Survey of the States." National Clearinghouse for Professions in Special Education, p. 1.

- Learning Disabled (LD)
- Speech Impaired (SI)
- Mentally Retarded (MR)
- Emotionally Disturbed (ED)
- Hard of Hearing/Deaf (HI)
- Multihandicapped (MH)
- Orthopedically Impaired (OI)
- Other Health Impaired
- Visually Handicapped
- Deaf-Blind

Exhibit 3.1 shows the relative sizes of various special education teaching categories, as described by the percentage of special education teachers in each category in the 1986-87 school year. About 80 percent of all special education teachers are included in the four largest categories: learning disabled, speech impaired, mentally retarded, and emotionally disturbed. In addition, approximately 28,000 teachers--about 10 percent of all special education teachers--are not included in any of the above categories and are certified in noncategorical special education.[15]

The difficulties that many school districts have experienced in hiring fully-certified special education teachers has led to the development of several types of temporary certification (e.g., emergency, provisional, and out-of-field), provided primarily to schools unable to hire fully-certified teachers.[16] Temporary certification is provided to teachers who are not fully qualified (or not fully-certified) to teach special education, often in school districts unable to hire an adequate number of fully-certified teachers. A 1983 study

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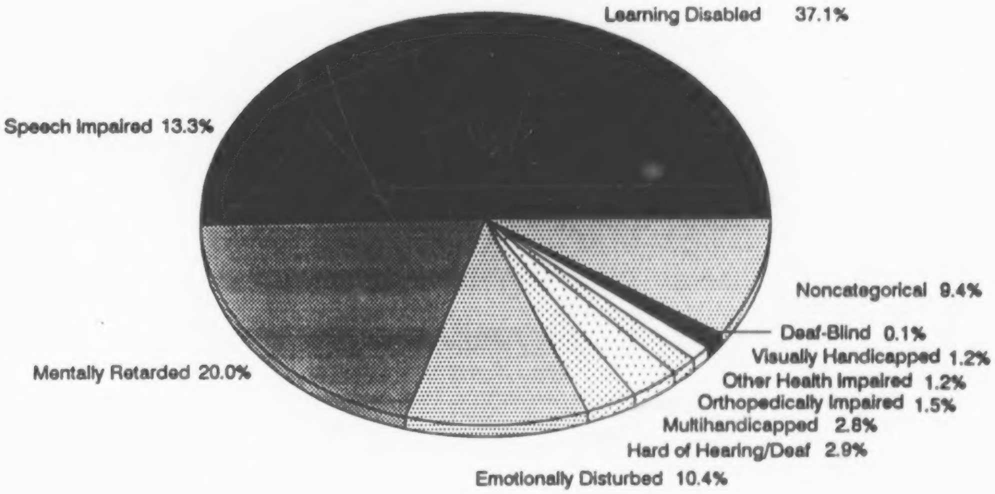
[15] U.S. Department of Education, Office of Special Education Programs and Office of Special Education and Rehabilitative Services (1989). Eleventh Annual Report to Congress on the Implementation of the Education of the Handicapped Act. Washington, D.C.: U.S. Department of Education, pp. A60-A62.

[16] Most states' laws stipulate that in order to hire teachers with temporary certificates, the school district first must have made a "reasonable search" for fully-certified special education teachers to fill their vacancies. Teachers who are not fully qualified obtain temporary certification through school system wishing to hire them.

Exhibit 3.1: Employment of Special Education Teachers by Category, 1986-87 Academic Year

Category	Number of Teachers	Percent of Total
Learning Disabled	109,630	37.1%
Speech Impaired	39,429	13.3%
Mentally Retarded	59,074	20.0%
Emotionally Disturbed	30,872	10.4%
Hard of Hearing/Deaf	8,588	2.9%
Multihandicapped	8,388	2.8%
Orthopedically Impaired	4,364	1.5%
Other Health Impaired	3,551	1.2%
Visually Handicapped	3,600	1.2%
Deaf-Blind	236	0.1%
Noncategorical	27,934	9.4%
TOTAL	295,666	100.0%



Note: The figures above refer to teachers in federally funded special education programs for all 50 states, D.C., and Puerto Rico, in the 1986-87 academic year. Note that this differs from the data presented in Exhibit 3.2.

Source: U.S. Department of Education, Office of Special Education Programs and Office of Special Education and Rehabilitative Services. Eleventh Annual Report to Congress on the Implementation of the Education of the Handicapped Act. Washington, D.C.: U.S. Department of Education (1989).

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reported that 48 of 54 jurisdictions in the United States provided some sort of emergency certification.[17] A 1990 study found that 78 percent of states responding to a survey have instituted their emergency certification procedures specifically to address critical shortages in special education.[18]

A 1986 study which surveyed education agencies in 41 jurisdictions found that 13 jurisdictions reported a general rise in the number of temporary certificates issued, 19 reported that they were issuing the same number of such certificates each year, and only 7 reported a declining number of temporary certificates being issued. Two jurisdictions claimed that the practice of issuing temporary certificates had been eliminated by legislative action.[19] One state official we interviewed said that in some areas in her state, between 2 and 20 percent of teachers in special education hold temporary certificates.

These special education teachers, however, are not generally regarded as permanent replacements for fully-certified teachers; rather, they are hired often as long-term substitutes or with short-term contracts, until the school is able to hire fully-certified replacements. In some cases certification is "provisional," given to teachers with the expectation that they will undertake special education training and obtain full certification within a fixed period of time. The distinction between fully-certified special education teachers and those with the types of temporary certification discussed here is important to the discussion of shortages. Temporary certificates are granted in the face of a shortage of fully-certified special education teachers; the long-term demand for fully-certified special education teachers, however, does not diminish with the presence of teachers with temporary certificates, but instead may be measured by them.

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[17] Sattler and Sattler (1985), p. 102.

[18] Fran O'Reilly (1990). State Emergency Certification Provisions -- Results of a 1990 Survey. Washington, D.C.: National Clearinghouse for Professions in Special Education, p. 1.

[19] Margaret J. McLaughlin, Judy Smith-Davis, and Philip J. Burke (1986). Personnel to Educate the Handicapped in America: A Status Report. College Park: Maryland: Institute for the Study of Exceptional Children and Youth, College of Education, University of Maryland, p. 44.

b. Changes in Requirements

The patterns of special education certification requirements are constantly changing; between 1982 and 1986, 37 out of 57 jurisdictions made some changes to their policies governing special education certification or had some changes pending.[20] Several dichotomies emerge in the certification and entry policies initiated by states in the 1980s. According to the Encyclopedia of Special Education:

> "On the one hand, there were movements to professionalize teaching, develop professional standards boards for teacher certification, make pre-service preparation more rigorous, and improve the overall quality of education provided.[21] On the other, there was widespread hiring of unqualified applicants through emergency certification and temporary certification waivers, which were allowed on the belief that in areas with critical shortages, having unqualified personnel was better than having none."[22]

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[20] McLaughlin et al. (1986), p. 7.

[21] The term "pre-service preparation" refers to education and training received prior to the time the teacher begins full-time teaching; analogously, "in-service training" refers to training and education the teacher receives after having begun teaching. See "In-Service Training for Special Education Teachers." Encyclopedia of Special Education (1988), p. 835.

[22] Judy Smith-Davis (1990). "Alternative Routes to Teacher Certification." National Clearinghouse for Professions in Special Education, p. 1.

This dichotomy was also noted by Darling-Hammond: "For every move to tighten certification requirements and raise standards, other steps were taken to loosen or waive them, often as a means of counteracting teacher shortages."[23]

The demand for special education teachers in the 1980s and the desire to attract more people into the field has led to interest in alternative routes to certification. "Alternative certification" requirements and state-sponsored alternative training programs allow individuals who are not trained in special education (often persons with bachelor's degrees in other areas of teaching or in other fields) to enter the field rapidly without the long undergraduate training process.[24] A typical alternative certification training program involves a summer course lasting six to eight weeks, followed by a paid supervised internship lasting up to one year, after which the teacher is expected to receive full certification.

The major concern regarding alternative certification programs is the impact that they may have on the quality of special education teaching. Critics claim that acceptance of such certification practices represents a reduction of teaching standards and will result in inadequately prepared teachers--and ultimately, ineffectively served children. Advocates of such programs, however, argue that alternative certification requirements, when thoughtfully developed, will maintain the quality of teaching in special education and still allow talented candidates to enter the field with ease.

Recent studies have found that most alternative education programs require baccalaureate degrees, have entrance requirements equal to or greater than those for university teacher education programs, emphasize practical training and experience over educational methods and training seminars, and involve ongoing supervision and evaluation of the candidates.[25] Although critics cite the potential danger of producing lower quality teachers, it is estimated that between 19 and 27 states have sponsored or planned alternative education programs, and more are likely to consider such programs if the perceived shortage of special education teachers in certain critical areas continues.[26]

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[23] L. Darling-Hammond. "The Futures of Teaching." Educational Leadership, 46(3), p. 5.

[24] Darling-Hammond, p. 5.

2. Methods Employers Use to Recruit Teachers

a. Vacancy Announcements

Traditionally employers--school districts and private schools--have recruited special education teachers as they did all other teachers, namely by contacting prospective teachers through college or university channels and professional conferences, or by placing advertisements in professional publications and newspapers. Word-of-mouth has also played an important role in attracting teachers, especially to districts or schools expanding special education programs and seeking experienced teachers.[27]

The general perception of a shortage in special education has led many school districts to devise and implement new strategies to attract and recruit special education teachers. For example, electronic bulletin boards have been recently developed by a number of education associations listing vacancies available for special education teaching posts around the country. Several state education agencies and associations have also created employment clearinghouses that compile and disseminate employment information about available teaching positions.[28]

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[25] L. Darling-Hammond, L.N. Hudson, and S. H. Kirby (1989). Redesigning Teacher Education: Opening the Door for New Recruits in Science and Mathematics Teaching. Santa Monica, California: The RAND Corporation. Cited by Judy Smith-Davis (1990). "Alternative Routes to Teacher Certification," p. 4.

[26] Darling-Hammond (1989).

[27] National Information Center for Children and Youth with Handicaps (1987). Special Education Personnel Recruitment Practices: A Manual for Administrators, p. 3.

While these new methods will not supplant the traditional recruiting techniques, there are certain advantages. Electronic bulletin boards and employment clearinghouses are accessible to any person or agency across the country, providing greater geographic reach than newspapers. They are less expensive and more up-to-date than professional journals, and they require none of the informal university channels that are inherently limited in range and number. Employment clearinghouses are able to provide prospective applicants with more recruiting material (e.g., brochures, information on requirements), and are able to monitor and assist applicants in their employment search.

b. Recruitment Practices

Making prospective applicants aware of teaching vacancies is not the only thing employers do to fill positions. Employers who perceive shortages of personnel often intensify their recruiting efforts and offer incentives to entice applicants. Shortages in special education, or the fear of them, have caused the proliferation of innovative methods used by school districts to attract promising applicants. These include:

- paying the expenses of applicants to visit their schools;
- assisting in the search for affordable housing;

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[28] For example, SpecialNet, a nationwide computer network developed by GTE and NASDSE (National Association of State Directors of Special Education), has an employment bulletin board that lists employment opportunities nationwide. Another electronic service is CAREER CONNECTION, which lists candidates seeking special education positions. Several state agencies have also developed such systems to rapidly and effectively disseminate teaching vacancy information (e.g., CAREER, a computerized job vacancy service for teachers and other educators, provides listings of openings in California public schools.)

- helping spouses of new employees find employment;
- paying tuition costs for teachers to return to college to obtain further education; and
- providing opportunities for summer employment.

Other employers sponsor job fairs for educators -- Florida has an annual "Teach In," that attracts students and teachers from around the country. In some districts, promising applicants are "sold on the advantages of the locale" (for example, some Florida counties send out-of-state prospects to Disneyworld).

3. Methods Teachers Use to Seek and Obtain Employment

The methods that special education teachers use to seek and obtain positions are generally the converse of the methods employers use, i.e., they employ the opposite ends of the same channels. Teachers generally use university postings, word-of-mouth, employment clearinghouses, and computer networks to find vacancies in teaching positions.

There is, however, variation in the methods used by different types of applicants. Entrants to special education teaching, namely newly-trained teachers or those who have recently obtained certification, generally rely on university-based channels, professional conferences, job fairs, and journals to seek and obtain teaching positions. With few exceptions, university-based channels are limited geographically within the state and to states with similar certification procedures.[29] Applicants certified in the field who are re-entering the profession -- who have recently obtained temporary or emergency certification or who have moved from other states -- are more likely to use employment clearinghouses or employer-based sources of information (advertisements, etc.), primarily due to their lack of other connections.[30]

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[29] Universities generally design their teacher education curricula around their state's certification requirements; consequently the requirements of in-state employers generally match university curricula and new teachers find it easiest to obtain jobs in the state in which they were educated.

4. Characteristics of Workers in the Occupation

Broad national data on the demographic characteristics of special education teachers are difficult to find. Although most of the information regarding the characteristics of people in the field is anecdotal, some facts are evident from surveys. According to the Current Population Survey:

- Special education teachers are more likely to be women; in 1988, 85.2 percent of special education teachers were women, compared to 72.9 percent for all teachers, and 44.8 percent of all full-time workers over the age of 16. These estimates are substantiated by the SASS (School and Staffing Survey) data for that year--in which 87.7 percent of special education teachers were women.[31]

- In 1988, 10.6 percent of special education teachers were black, as compared to 8.8 percent of all teachers and 10.1 percent of all workers. Only one percent of special education teachers were of Hispanic origin, much less than the 3.9 percent of all teachers and the 7.2 percent of all workers.

- In the period between 1983 and 1988, the national percentage of special education teachers who were women and those who were black has not changed. The national percentage of special education teachers who were of Hispanic origin, however, declined from 2.3 percent in 1983 to 1.0 percent in 1988.[32] [33]

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[30] Many of those who receive temporary or emergency certification are general education teachers who are simply reassigned within the same school district, and thus the need for a job search is often unnecessary.

[31] E.E. Boe, Lynne Cook, Martin Raufman, and Louis Danielson (1990). Preliminary analysis of the SASS data for the 1987-88 academic year. Unpublished tabulations.

[32] U.S. Department of Labor, Bureau of Labor Statistics (Aug. 1989). Handbook of Labor Statistics. Washington D.C.: Government Printing Office, pp. 79-95.

Studies that have observed the characteristics of special education teachers have also found that "the teacher population in special education is generally younger than the population in regular education," reflecting the rapid growth in employment in the field and the fact that "nearly 50 percent of newly trained [special education] teachers leave within their first six years of teaching."[34] According to the SASS survey, the mean age of fully-qualified special education teachers is 38.3, compared to 41.7 for general education teachers.[35]

C. Employment and Earnings in Special Education Teaching

1. Employment Trends

This section describes and analyzes trends in the employment and earhings of special education teachers in the United States. These trends, analyzed in comparison with the number of exceptional children and the size of the overall teaching profession, provide insight into the size and history of the labor market for special education teachers.

The primary source of information concerning the number of special education teachers is the Office of Special Education Programs (OSEP) in the U.S. Department of Education, which is charged with compiling and analyzing employment data on special education programs and personnel; data is based primarily on the survey responses of the

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[33] While national demographic characteristics have not significantly changed, it is important to note that these characteristics may have changed at the state and local level, for which data are unavailable.

[34] Erika G. Bogenschild, Paul Lauritzen, and Linda Metzke (1988). "A Study of Teacher Attrition." National Clearinghouse for Professions in Special Education, p. 1.

[35] Boe (1990).

state departments of education, which are mandated by PL 94-142 to provide data on their special education programs.[36]

At the outset, it is important to list several caveats concerning the employment data discussed below. According to several researchers who have used and studied the employment data reported in the Annual Report to Congress, the information provided by the states on the number of special education teachers needed is not very reliable, for a number of reasons. First, there are semantic issues as to who exactly is considered a "special education teacher." Although OSEP specifically requests that only "fully-certified"[37] teachers currently assigned to teach special education be classified as "special education teachers," many states, due to definition differences, also include teachers with temporary, provisional, and emergency certification who teach special education. Thus, teachers who are less than fully-certified and who might be replaced by fully-certified teachers are often included.

Second, some data requested by OSEP are not collected by many states because the state agencies do not have a system capable of collecting the requested data; this results in the reported figures being very rough estimates by state officials. Third, changes in definitions of categories and the emergence of new categories have altered category-specific supply information, making analysis of such data over time suspect. For instance, many of the teachers who are currently classified as "noncategorical" may have been reported as "learning disabled" teachers prior to the widespread acceptance of the noncategorical classification. The result is that categories are not comparable over time or between states. Fourth, researchers have noted that some of the data reported in the Annual Report have been discrepant with corresponding data released directly by the states.

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[36] Eleventh Annual Report to Congress on the Implementation of the Education of the Handicapped Act (1989), pp. 100-103.

[37] "Fully-certified," as defined by OSEP, is the completion of the graduate education and internship training required by the state.

Finally, school districts may under-report the number of vacancies in special education, resulting in inaccurate data at the state level. The explanation for this final point rests in a "Catch-22" situation in which school districts are placed: reporting a large number of vacancies is an admission that the locality is not in compliance with federal (and often state) regulations. This, in turn, may increase the risk of litigation from parents and elicit pressure from the state government. These fears create a clear incentive for school districts to under-report vacancies, even when accurate information is available. This last motive has led several researchers with whom we talked to believe that there may be a substantial under-reporting bias to the demand and shortage data.

Despite these flaws, the statistics provided are the best national data available and are widely used in research and in guiding policy. Moreover, our purpose in this section is to provide only a general context for the examination of shortages, and the usefulness of the information outweighs the potential risks. When used in other sections of this chapter, the data will be used only to substantiate conclusions and information found in other sources.

Exhibit 3.2 presents the trend in the number of special education teachers in the 50 states and the District of Columbia from 1976 to 1987.[38] As the figure reveals, the number of special education teachers employed has increased every year during this period

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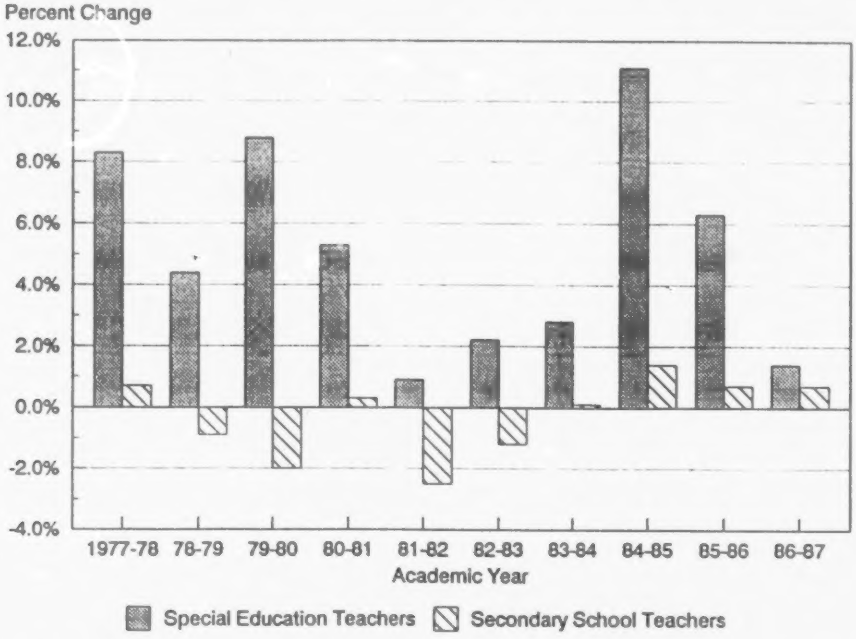
[38] Figures are reported on December of each year. See Annual Report to Congress on Implementation of the Education of the Handicapped Act, various years.

Exhibit 3.2: Number of Special Education Teachers and Secondary School Teachers, 1976-1987

Academic Year	*Employment*		*Percent Change*	
	Special Education Teachers *(In thousands)*	Secondary School Teachers *(In thousands)*	Special Education Teachers	Secondary School Teachers
1976-77	178.8	1,105	-	-
1977-78	193.6	1,113	8.3%	0.7%
1978-79	202.0	1,103	4.4%	-0.9%
1979-80	219.8	1,081	8.8%	-2.0%
1980-81	231.4	1,084	5.3%	0.3%
1981-82	233.5	1,057	0.9%	-2.5%
1982-83	238.6	1,044	2.2%	-1.2%
1983-84	245.3	1,045	2.8%	0.1%
1984-85	272.4	1,060	11.1%	1.4%
1985-86	289.5	1,067	6.3%	0.7%
1986-87	293.5	1,075	1.4%	0.7%
1987-88	NA	1,076	NA	0.1%
Average			5.1%	-0.2%



Note: Data for special education teachers include 50 states and D.C. for December of each school year; New Mexico reported no figures prior to 1984-85. Figures for secondary school teachers are for 50 states and D.C., and include special education teachers who teach in secondary schools.

Source: U.S. Department of Education, Office of Special Education Programs and Office of Special Education and Rehabilitative Services. Annual Report to Congress on the Implementation of the Education of the Handicapped Act. Washington, D.C.: U.S. Department of Education (Various Years). Also, U.S. Department of Education, National Center for Education Statistics. Digest of Education Statistics. Washington, D.C.: U.S. Department of Education (1989).

at an average annual rate of about 5.1 percent, resulting in an estimated 293,539 teachers in 1987. In contrast, the overall number of secondary school teachers grew very little in this period, with several years of decline and an average growth rate of about -0.2 percent annually.

Although employment growth in special education teaching has been rapid over the last decade, the future does not seem as optimistic. The Bureau of Labor Statistics estimates that between the years 1988 and 2000, the total number of special education teachers employed will increase 16 percent, compared to the estimated 15 percent increase for kindergarten and elementary school teachers, 19 percent for secondary school teachers, and 15 percent for all occupations.[39] This increase is also not expected to match the increase in the number of college educated persons in the labor force, estimated at about 30 percent for this period.[40]

This expected growth in the employment of special education teachers, however, by no means reflects the total number of entrants needed in this period; many more new special education teachers will be needed to replace those who retire, leave the field, or die (i.e., "replacement demand"). The estimated replacement demand for special education teachers in this period is 14.2 percent annually, and accounts for most of the vacancies created in the field; this rate is the highest in teaching -- elementary and secondary school teachers have rates of 11.1 percent and 9.1 percent, respectively.[41]

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[39] Refers to changes in civilian employment under the moderate scenario for economic growth between 1988 and 2000. The estimate of future employment growth for special education teachers is based upon a set of assumptions about the growth in the number of exceptional children, the percentage who are served, the expected intensity of service, and the expected student-teacher ratios recommended by states. Deviation from these assumptions would naturally alter this estimate. George Silvestri and John Lukasiewicz (Nov. 1989). "Projections of Occupational Employment: 1988-2000." Monthly Labor Review. Vol. 112(11), pp. 42-66.

[40] Lewin/ICF analysis of Bureau of Labor Statistics (BLS) and Current Population Survey (CPS) data. See also, U.S. Department of Labor, Bureau of Labor Statistics, Division of Labor Force Statistics (July 1988). Educational Attainment of Workers: March 1988. Unpublished tabulations.

2. Earnings Trends

As discussed in Chapter 2, the rate at which wages in an occupation change is often an important indicator of labor market dynamics, especially in the short run. In occupations where market forces move freely (i.e., supply, demand, and wages are not regulated by the government), a rapid rise in wages may indicate the presence of a shortage. Wages in special education, as with many occupations supported by federal funds, do not necessarily behave in this manner. Almost all of the experts and officials we interviewed said that generally wages for special education teachers are on the same salary scale as those of all other teachers. In other words, a predetermined salary system, rather than market forces, determines wages for special education teachers. It is important nevertheless to observe the trends in the median wages for special education, as compared to other professions.

Exhibit 3.3 shows the median weekly earnings in the United States for special education teachers for the period 1983 to 1990, in comparison with (a) secondary school teachers, (b) elementary school teachers, (c) persons with four or more years of college education, and (d) all full-time salary and wage workers over the age of 16. In 1983, the median weekly earnings for special education teachers were $335, compared to $361 for

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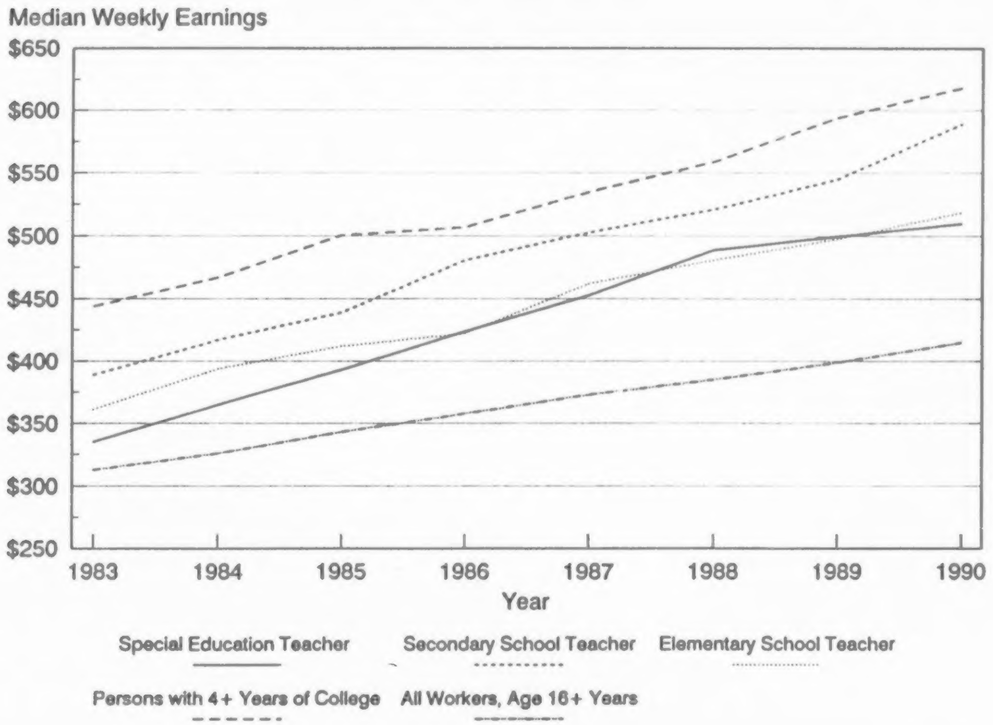
[41] Malcolm S. Cohen (1990). Study on the Feasibility of Using Labor Market Information for Alien Labor Market Certification Determination. Final Report for the U.S. Department of Labor, Employment and Training Administration, pp. 56-58.

Exhibit 3.3: Median Weekly Earnings for Special Education, Elementary School, and Secondary School Teachers; College Graduates and All Workers, 1983-1990

Year	*Teachers*			Person 4+ Years of College	All Workers 16 Years +
	Special Education	Secondary School	Elementary School		
1983	$335	$389	$361	$444	$313
1984	365	417	394	467	326
1985	393	439	412	501	343
1986	424	481	422	507	358
1987	453	503	462	535	373
1988	489	521	481	559	385
1989	500	545	498	594	399
1990	510	589	519	618	415



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

all elementary school teachers and $389 for all secondary school teachers.[42] College graduates on average earned $444 per week and all workers earned $313. In 1990, earnings for special education teachers had risen to $510, higher than the $415 for all workers, but still less than the $519, $589 and $618 earned by elementary school teachers, secondary school teachers, and all college graduates, respectively.[43]

In terms of detecting and analyzing shortages however, wages themselves are not as important as how they change over time, especially relative to those for other professions. As economic theory suggests, changes in earnings are important indicators of shortages in freely moving labor markets; although the labor market for special education teachers may not be very flexible in terms of wages, this indicator is nevertheless important to consider. As Exhibit 3.4 reveals, median weekly earnings for special education teachers have been rising at an average rate of 6.2 percent between 1983 and 1990, faster than earnings for secondary school teachers (6.1 percent), elementary school teachers (5.3 percent), college graduates (4.8 percent), and all full-time workers (4.1 percent) in the same period.[44]

If it is true that special education teachers are paid on the same salary schedule as all other teachers, the explanation for the faster wage growth may rest in the changing

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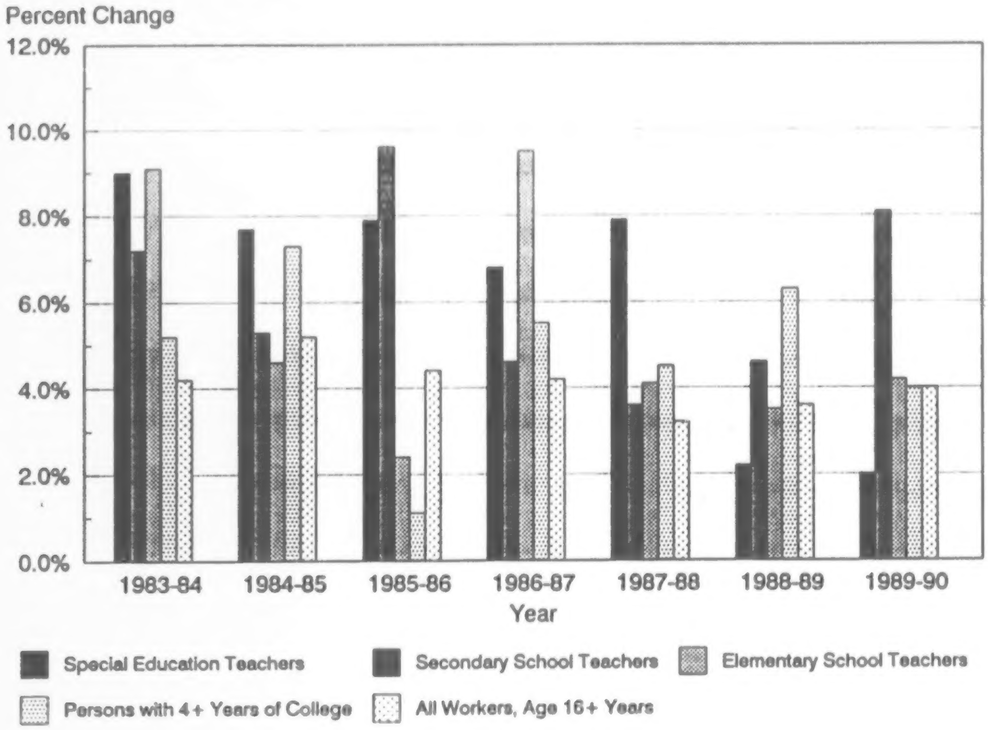
[42] The term "college graduates," as used in the discussion of earnings, refers to all persons age 16 or over, who have completed four or more years of college. The term "all workers" refers to all full-time wage or salary earners 16 years and older.

[43] U.S. Department of Labor, Bureau of Labor Statistics (Aug. 1989). Handbook of Labor Statistics. Bulletin 2340. Washington, D.C.: Government Printing Office, p. 169-199. Also, U.S. Department of Labor, Bureau of Labor Statistics, unpublished tabulations from the Current Population Survey, various years. Also, Cohen, analysis of Current Population data, various years.

[44] The term "all full-time workers" refers to the Bureau of Labor Statistics category "all full-time wage and salary workers."

Exhibit 3.4: Change in Median Weekly Earnings for Special Education, Elementary School, and Secondary School Teachers; College Graduates and All Workers, 1983-90

Year	*Teachers*			Person 4+ Years of College	All Workers 16 Years +
	Special Education	Secondary School	Elementary School		
1983-84	9.0%	7.2%	9.1%	5.2%	4.2%
1984-85	7.7%	5.3%	4.6%	7.3%	5.2%
1985-86	7.9%	9.6%	2.4%	1.1%	4.4%
1986-87	6.8%	4.6%	9.5%	5.5%	4.2%
1987-88	7.9%	3.6%	4.1%	4.5%	3.2%
1988-89	2.2%	4.6%	3.5%	6.3%	3.6%
1989-90	2.0%	8.1%	4.2%	4.0%	4.0%
Average	6.2%	6.1%	5.3%	4.8%	4.1%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

demographic structure of the occupation. The large disparity between the average earnings of special education teachers and all teachers in the early 1980s may be explained by the difference in the average ages of the two groups. Special education teachers in the early 1980s tended to be much younger than teachers in general, due to the young age of the profession itself. As the field matured, however, over the course of the decade, the average age of people in the profession increased relative to that of all teachers, and this resulted in a faster increase in the median wages. Therefore, although the wage data are consistent with the behavior that one would expect in a field experiencing a shortage of qualified personnel, other explanations for the relatively rapid rise in wages are more likely given our knowledge of the salary structure for teachers.

In addition to their salaries, special education teachers enjoy the same benefits as other teachers, including health and life insurance, summer vacations, and pension plans. These are more generous than those for most non-teaching professions. In addition, one state official we interviewed stated that special education teachers who desire additional summer employment can generally find it within the school system. Other benefits have recently been introduced by some school districts to attract special education teachers; these will be further discussed in Section E of this chapter.

3. Average Annual Unemployment Rate

Another key indicator of labor market shortages is the annual average unemployment rate in that occupation. Occupations experiencing shortages, in which the number of vacancies is greater than the number of qualified applicants, are likely to have very low unemployment rates -- since those searching for jobs find them quickly, and are thus unemployed for a very short period.[45] Exhibit 3.5 graphs the trend in the annual unemployment rate for special education teachers, secondary and elementary school teachers, college graduates, and all workers. The annual unemployment rate for special education teachers averaged 1.9 percent between 1983 and 1990; the comparable rates for secondary school teachers and elementary school teachers in this period were 1.7 percent and 2.0 percent, respectively.[46] The unemployment rate in this period for all college graduates was 2.4 percent and for all workers was 6.7 percent.[47] Although the low unemployment rate for special education teachers indicates a tight labor market and is consistent with the presence of a shortage, it does not conclusively prove it. For example, both elementary and secondary school teaching, neither of which are experiencing shortages, have similar unemployment rates.

D. Factors Contributing to a Labor Shortage

1. Presence of a Shortage

Most academic literature as well as officials we interviewed agreed that there is a national shortage of special education teachers, although several did say that some special education specialties may have surpluses in some geographic areas. Almost all characterized the shortage as severe and persistent (i.e., lasting five years or more), and

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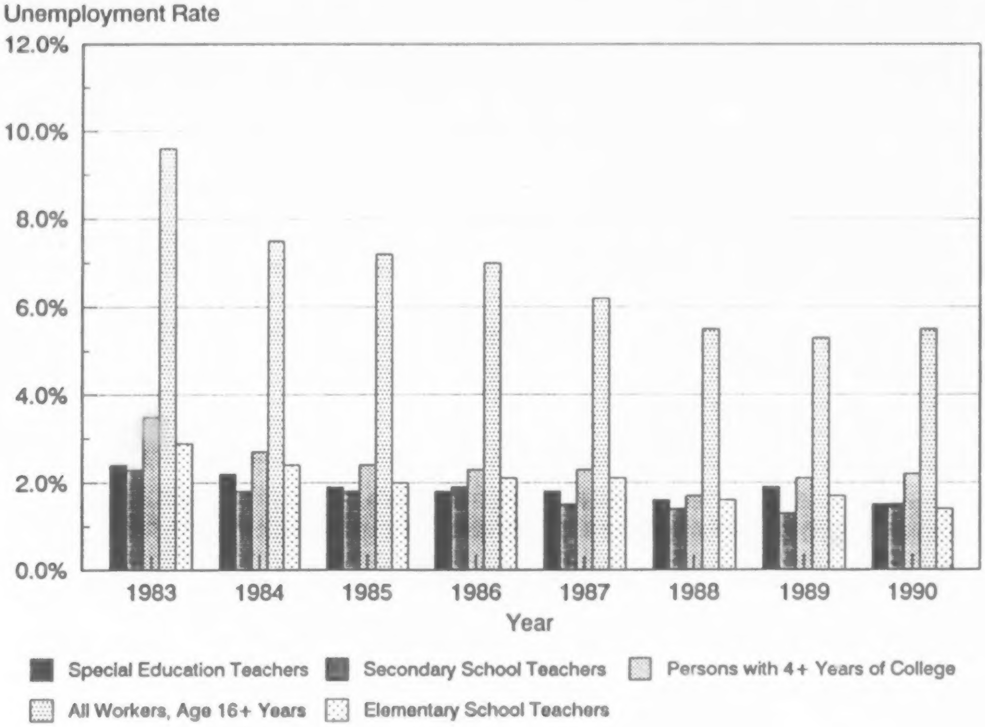
[45] Cohen (1990), pp. 33-40.

[46] The period from which the average unemployment rate for persons age 25 to 64 with four or more years of college education was calculated was March 1983 to March 1988; comparable 1989 data were not available.

[47] Analysis of Current Population Survey, various years as cited in Cohen, pp. 33-40. Also, U.S. Department of Labor (Jan. 1990). Employment and Earnings. Also, U.S. Department of Labor, Bureau of Labor Statistics (August 1989). Handbook of Labor Statistics. Bulletin 2340. Washington D.C.: Government Printing Office, p. 169. The unemployment information represents the rate for persons between the ages of 25 and 64.

Exhibit 3.5: Unemployment Rate for Special Education, Elementary School, and Secondary School Teachers; College Graduates and All Workers, 1983-90

Year	*Teachers*			Person 4+ Years of College	All Workers 16 Years +
	Special Education	Secondary School	Elementary School		
1983	2.4%	2.3%	2.9%	3.5%	9.6%
1984	2.2%	1.8%	2.4%	2.7%	7.5%
1985	1.9%	1.8%	2.0%	2.4%	7.2%
1986	1.8%	1.9%	2.1%	2.3%	7.0%
1987	1.8%	1.5%	2.1%	2.3%	6.2%
1988	1.6%	1.4%	1.6%	1.7%	5.5%
1989	1.9%	1.3%	1.7%	2.1%	5.3%
1990	1.5%	1.5%	1.4%	2.2%	5.5%
Average	1.9%	1.7%	2.0%	2.4%	6.7%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

expect the shortage to last for the next five years.

a. Severity of the Shortage

The Annual Report to Congress reports that 26,798 additional special education teachers were needed in the United States for the 1986-87 school year, about nine percent of the total number of special education teachers employed in that year.[48] A recent study on teacher shortages found that categories in special education comprised 5 of the top 10 teaching specialties with the most severe shortages.[49] The categories within special education found in this and other studies to have the most severe shortages are multihandicapped (including deaf/blind), severe emotionally disturbed, severe mentally retarded, visually impaired, hard of hearing/deaf, learning disabled, and speech impaired.[50] Exhibit 3.6 presents the number of fully-certified teachers, by category, which states report as needed, as a percentage of fully-certified teachers employed in that category in the 1986-87 academic year.[51] In general, categories dealing with more severe handicapping conditions tend to have more severe shortages, while categories dealing with a variety of mild handicapping conditions tend to have less marked

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[48] The term "needed" represents the number of vacancies that occurred, even if subsequently filled, and the number of additional personnel necessary to fill positions occupied by less than fully qualified staff. Source: Annual Report to Congress on the Implementation of the Education of Handicapped Act, various years. The figures for the total number of teachers needed in 1986-87 include 50 states, D.C., Puerto Rico, and the insular territories.

[49] Association of School, College, and University Staffing (ASCUS) (1988). Teacher Supply and Demand in the United States: A Look Ahead, ASCUS Research Report, p. 5. Other teaching specialties included Physics, Chemistry, Mathematics, Secondary Computer Education, and Elementary Computer Education.

[50] ASCUS (1988), p. 5. Also, McLaughlin, (1988), p. 35.

[51] These figures are for the 50 states, D.C., Puerto Rico, and the insular territories.

Exhibit 3.6: Number and Percentage of Special Education Teachers Needed, by Category, Academic Year 1986-87

	Teachers Needed	Number Needed as a Percentage of Employed
Learning Disabled	9,564	8.7 %
Speech Impaired	3,019	7.6
Mentally Retarded	4,880	8.3
Emotionally Disturbed	4,650	15.1
Hard of Hearing/Deaf	631	7.3
Multihandicapped	910	10.8
Orthopedically Impaired	326	7.5
Other Health Impaired	376	10.6
Visually Handicapped	261	7.3
Deaf-Blind	35	14.6
Noncategorical	2,143	7.6
Total	26,798	9.0

Note: The figures above refer to teachers in federally funded special education programs for all 50 states, D.C., Puerto Rico, and the insular territories for the 1986-87 academic year. Note that these figures are not directly comparable to those reported in Exhibits 3.1 and 3.2. The term "needed" is defined as the number of vacancies which existed in the school year (even ones subsequently filled) and the number of less than fully qualified special education teachers employed. This indicates the gap between the number of fully certified teachers employed and the number legislated by the states.

Source: U.S. Department of Education, Office of Special Education Programs and Office of Special Education and Rehabilitative Services. Eleventh Annual Report to Congress on the Implementation of the Education of the Handicapped Act. Washington, D.C.: U.S. Department of Education (1989).

shortages.[52]

b. Geographic Distribution of the Shortage

Considering the wide variety of policies affecting special education among states, it is not surprising that the shortage of special education teachers is not equally severe throughout the nation. Several studies that have analyzed the patterns of shortages in special education have found that:

- States in the West (e.g., California, Nevada, Utah, and Arizona), South Central (e.g., Texas and Oklahoma), and Southeast (Virginia and Florida) report the most severe shortages.
- The Great Lakes and Middle Atlantic states report less severe shortages. This may be attributed to the large number of teacher training institutions in those areas.
- Alaska, the state with the highest average teacher salaries, reports the least shortage of special education teachers.[53]

Although several states have reported surpluses of special education teachers, these are generally located in suburban and prosperous urban areas of the states and tend to be of teachers specializing in mild handicapping conditions such as Speech Impairment, Mild Noncategorial special education, Learning Disabilities, and Mild Mentally Retarded.[54] Only two states report general surpluses in most geographic areas: Rhode Island and Pennsylvania.

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[52] Annual Report to Congress on the Implementation of the Education of the Handicapped Act, various years. Also, McLaughlin (1986), pp. 35-37.

[53] McLaughlin (1986), pp. 35-37. Also, ASCUS (1988), p. 6.

[54] McLaughlin (1986), p. 38.

2. Demand-Side Factors

An understanding of the factors influencing demand for special education teachers is particularly important in education, as the traditional determinants of demand for labor relevant for private firms, such as the revenue and costs per worker, do not apply.[55] This section will discuss the factors, and their role in determining the size and nature of the shortage in special education teaching.

a. Class Sizes

The demand for special education teachers is governed, in a broad sense, by an array of federal and state legislation that mandates "a free and appropriate" education for all handicapped children.[56] To comply with these fundamental requirements and to maintain their own quality standards for special education, state educational agencies have developed guidelines to control several variables regarding special education. The most important of these are the student-teacher ratios suggested for each handicapping category. These guidelines, reflecting each state's educational philosophy, are a major determinant of the total demand for special education teachers, linking the number of teachers employed to the number of exceptional children in the state.[57] School districts, in turn, base their hiring decisions on these guidelines. A portion of the growth in demand that goes unfilled in the shortage stems from the changes in these ratios over time.

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[55] This is not completely true; the demand for special education teachers by private schools and institutions may be determined to a limited degree by competitive market dynamics, but for the sake of simplicity this aspect will not be considered here. See Ronald G. Ehrenberg and Robert S. Smith (1988). Modern Labor Economics: Theory and Public Policy. Third Edition. Glenview, Illinois: Scott, Foresman, and Company, p. 69.

[56] The Education for All Handicapped Children Act (EHA). See page 3-3 of this chapter.

[57] See McLaughlin (1986), p. 73. In many states, the ratios provided at the state level are mandated rather than suggested; in these cases, variation from the requirements demands formal waivers.

reflecting higher standards and "an improved understanding" of, or changing perceptions of, effective teaching practices for exceptional children.

Although changes in these ratios do not cause shortages any more than an increase in demand for furniture causes a shortage of carpenters, the increasing demand contributes to the persistence of the shortage--often aggravating the inability of the market to return to equilibrium. Conversely, shortages of teachers have an effect on adherence to the ratios; one study, finding that shortages increase the number of waivers granted to districts to deviate from established ratios, concluded that it "is clear that ratios are still being adjusted to accommodate both manpower shortages and economic constraints, and the impact on program quality is unknown."[58]

b. Early Intervention

Demand is also influenced by policies designed to identify exceptional children at an increasingly young age, with the belief that introduction of special education for many handicaps is most effective in young children. This increase in the practice of early identification and intervention also contributes to an increased demand for special education teachers.

c. Fiscal and Budgetary Constraints

As with all public programs, fiscal and budgetary issues have considerable influence on the demand for special education teachers. School districts hire based upon the number of unfilled budgeted vacancies and the number of teachers needed to replace less than fully-qualified teachers. Budget cuts can significantly reduce the overall number of teachers needed and thus might reduce the size of the shortage. Likewise, an increase in federal or state funding for special education teachers may prompt decreases in student-teacher ratios and increases in the number of budgeted vacancies, thus exacerbating the shortage. It has been difficult, however, to isolate the independent effect of budgetary factors; schools and states, in simultaneously changing other factors affecting teacher demand during a period of budgetary change, obscure the impact of fiscal-budgetary policy on demand.

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[58] McLaughlin (1976), p. 77.

d. Mainstreaming Issues

Another major factor that affects school districts' hiring decisions is the degree to which they mainstream students. Educational research and several resulting state mandates specify that exceptional children must be placed in the "least restrictive environment" in which they can effectively learn. More specifically, this may mean that special education programs must "provide for education of the exceptional pupil, to the maximum extent appropriate, with other pupils who do not have handicapping conditions."[59] For example, a student with a mild learning disability, requiring only a few special education classes, would be prevented by this mandate from being placed full-time in a special education class and isolated from mainstream peers. This mandate, however, provides plenty of latitude regarding the degree of special educational intervention that schools can provide -- and consequently the number of special education teachers necessary to teach those students. Although the impact of mainstreaming policy on the current size and severity of the shortage is uncertain, one expert whom we interviewed stated that as education research makes the advantages and disadvantages of mainstreaming more clear, the impact of mainstreaming policy on the future supply and demand for special education teachers is likely to be extremely significant.

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[59] New York State Education Department, Office for Education of Children with Handicapping Conditions (Feb. 26, 1987). Regulations of the Commissioner of Education, Subchapter P: Part 200--Children with Handicapping Conditions, p. 2.

3. Supply-Side Factors

Our interviews revealed a number of significant factors affecting the supply of special education teachers, most concerning the demands placed on and the opportunities available to both special education teachers and those seeking to enter the profession. Attracting more individuals into special education training programs and keeping fully-certified special education teachers in the field seemed to our interviewees to be crucial to solving the shortage. One expert stated that "all evidence suggests that there's a big pool of qualified special education teachers who aren't teaching special education. Many are teaching general education, others work in areas completely unrelated to education simply because they don't want to move to areas where the jobs are." In this section we discuss the importance of various aspects of the supply of special education teachers in determining the nature of the shortage.

a. Attrition

The most often cited factor affecting the supply of special education teachers is the high attrition rate. Unlike most fields, in which exit from the profession is often due to retirement or family commitments, special education seems to have a particularly high rate of "burnout" due to the pressures and responsibilities inherent in the profession. In many states, the number of special education teachers necessary to replace teachers who leave prematurely is much greater than that of teachers needed due to changes in student population, changes in policy, retirement, or death. The literature suggests that the average national rate of attrition for special education teachers is among the highest for teaching specialties -- between 8 and 12 percent annually; one study based on a national sample of teachers estimated it at 9.7 percent in public schools and 18.1 percent in private schools.[60] The comparable statistics for all teachers are 4.1 percent and 8.7 percent, respectively.[61] For beginning emotional disturbances teachers, the rate of attrition due to burnout and related factors has been found to be as high as 21 percent at the end of the first year of employment with up to 53 percent having left by the end of the fifth year.[62] These estimates are further substantiated by statewide studies of attrition in Wisconsin (13.7 to 15.6 percent), Michigan (10 percent), Illinois (12 percent), and Kansas (9.9 percent).[63]

Burnout is a "syndrome of emotional exhaustion and cynicism that frequently occurs among individuals who do 'people work'--spend considerable time in close encounters with others under conditions of chronic tension and stress."[64] It is characterized by discouragement, loss of morale, and isolation, often due to job or work-related factors including stress, lack of feedback concerning progress and success, and excessive responsibilities and paperwork.[65] The causes of burnout in special education have been attributed to several important aspects of the field:

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[60] Also, Mary Rollefson (1991). "Teacher Turnover: Patterns of Entry to and Exit from Teaching." NCES Presentation to the 1990 Annual Meeting of the American Educational Research Associates, pp. 2-3.

[61] For the figures reported, "attrition from the profession" is defined as the number of teachers holding full-time positions last year who are no longer teaching in that school less those known to be teaching elsewhere. See Rollefson (1991), p. 2.

[62] C.V. Morsink (Feb. 1988). "Changes in the Role of Special Educators: Public Perceptions and Demands." Exceptional Educators Quarterly, pp. 15-25.

[63] Joseph Gomez (1986). Special Education Personnel in Michigan Public Schools 1978-86. Lansing, Michigan: State Board of Education; and Illinois Board of Education (1981). Illinois Supply and Demand for Special Education Personnel. Springfield, Illinois: State Board of Education. 1981; Paul McNab (1989). "Attrition of Special Education Personnel in Kansas." National Clearinghouse for Professions in Special Education, p. 8.; and Erika Bogenschild, Paul Lauritzen, and Linda Metzke (1988). "A Study of Teacher Attrition." National Clearinghouse for Professions in Special Education, p. 4. These attrition figures are for all teachers leaving employment in their certification category within the state, regardless of reason.

[64] Jennifer M. Platt (1990). "Why Teachers Are Leaving Special Education." Teacher Education and Special Education. 13(3-4), p. 192.

- The lack of administrative support in dealing with the paperwork and regulations imposed upon special education by state and federal government agencies is often cited. The desire by states to improve and monitor special education programs has led to greater accountability on the part of special education teachers, requiring them to record and report the progress made by each individual student. Special education departments in schools, usually organizational appendages of the mainstream programs in schools, often lack skilled administrators to assist teachers in dealing with these burdens.
- Fear of possible litigation placed on teachers by increasingly watchful parents who are intent on ensuring that their children's needs are served.
- Special education teachers in categories serving severely emotionally disturbed or mentally retarded students have higher burnout rates due to long periods of exposure to students each needing individual attention and the frustrations derived from a perception of helplessness in effectively dealing with their students' conditions.[66]

b. Certification Requirements

A factor that can greatly affect the number of out-of-state entrants is the lack of uniformity among state certification requirements. Special education teachers who migrate to a state in which they are not certified must often undertake additional training to fulfill the new state's requirements.[67] This burden of additional training discourages geographic mobility of special education teachers for new entrants, current teachers, and those returning to the field. In states where in-state training of new entrants and trained re-entrants meets only a small portion of the total demand for teachers, the impact of such disincentives may be significant.

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[65] H.N. Chandler (1983). "The Loneliness of the Special Education Teacher." Journal of Learning Disabilities, 16(2), pp. 126-127.

[66] Chandler (1983), pp. 126-127.

[67] Special education teachers who find jobs in states other than the ones in which they are currently certified are usually granted temporary certification until they fulfill all the additional requirements.

Several states are currently attempting to solve this problem through reciprocity agreements -- which allow teachers with certification in one state to automatically obtain certification in another state -- with neighboring states. States believe such agreements will increase the portability of special education training and encourage migration to states with the most severe shortages. Some researchers and associations have also argued for national certification for special education teachers. This, they argue, will establish national standards and categories for special education teaching, provide for uniformity in training and education requirements, and encourage more mobility between jurisdictions.[68]

c. Teacher Education and Training

Several key factors were mentioned during the interviews regarding the education and training of special education teachers. Many pointed out that one reason not enough people enter special education is the length of the training: in order to obtain certification, many states require a total of five to six years of undergraduate education, graduate education, and internships -- more time than it takes to obtain certification in general education. Although none of those whom we interviewed advocate shortening training, they were clear in listing the long training period as a factor in many students' decisions not to enter the field.

d. Teacher Wages

From an economic perspective, the prevailing salary for special education teachers seems an obvious area of interest. As discussed in the previous section, special education teachers generally earn the same as their general education peers, despite the additional stresses and burdens placed on special education teachers and the greater training required of them. There is a lack of differentials in wages that in other professions would compensate for the added disadvantages and responsibilities.

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[68] Strosnider and Little (1988), pp. 168-171.

One method of determining the importance of wages in attracting and retaining special education teachers is to observe employers who offer financial incentives to attract teachers. One state director for special education commented that several counties in her state have been successful in attracting out-of-state special education teachers with starting bonuses and higher wages, and that one of these counties currently reports no shortage of special education teachers. It is also interesting that Alaska, the state with the highest average teacher salaries, and Wyoming, with relatively high teacher salaries, reported virtually no shortage of special education teachers in 1986.[69]

The overall opinion among the experts we spoke with on the importance of teacher salaries as a factor in causing or aggravating the national shortage in special education was mixed, reflecting each person's institutional background and preferences. While some argued that salary increases for special education teachers were not the solution to the shortage, others insisted that salary differentials "would certainly attract individuals into the field and provide incentives to stay."[70] All of them agreed, that considering all the administrative and emotional stress placed on special education teachers, "it is not surprising that for the same amount of money many special education teachers find it easier to move into general teaching." Most also agreed, however, that salary differentials between teachers would be very difficult to institute and implement given the nature of the teaching profession and the wage negotiation process between teachers and employers.

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[69] McLaughlin (1986), p. 48.

[70] Also, Sattler and Sattler (1985), p. 99.

e. Geographic Disparities

Most of those whom we interviewed, and the literature as well, indicate that the shortage, although nationwide, is more severe in certain geographic areas. Rural and inner city districts, as well as districts far from teacher education institutions, generally report more severe shortages than suburban districts. This is especially true in low incidence or high severity categories such as visually impaired, deaf-blind, severe emotionally disturbed, and severe mentally retarded.[71] Two major reasons are offered:

- **Spousal Considerations:** Special education teachers who are married tend to avoid jobs in rural areas due to the employment considerations of their spouses. "The teacher in a family is most often not the primary wage earner, which makes it unlikely for them to relocate to where there is a need for teachers. One study found that the careers of over 60 percent of pre-service teachers are affected by the careers of significant others."[72]

- **Economic Considerations:** Many special education teachers avoid jobs in inner city areas due to the high cost of living in urban environments. Inner city school districts, which generally do not offer compensating differentials for the disadvantages and dangers of teaching in urban schools relative to suburban schools, find it more difficult to hire fully-certified special education teachers.

f. Prestige of the Teaching Profession

A final factor cited as discouraging people from entering special education teaching reflects the broad pattern of social attitudes toward the entire teaching profession. A number of the persons we interviewed expressed concern over the loss of prestige that was formerly attached to teachers and teaching; they felt that this has led to a lower number of talented individuals entering the profession, which in turn has led to a decline in the quality of education as well as to shortages in fields such as special education.

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[71] Sattler and Sattler (1985), p. 101.

[72] P. Lauritzen (1990). "Wisconsin Teacher Supply and Demand: An Examination of Data and Trends, 1990." Madison, Wisconsin: Wisconsin Department of Public Instruction. As cited in Paul Lauritzen and Stephen J. Friedman (Winter 1991). "Teachers with Emotional/Behavioral Disorders: Education's Greatest Challenge." Preventing School Failure. Vol.35, No. 2., p. 14.

E. Adjustments to Shortages

This section discusses what various groups are doing in response to the shortage of special education teachers. The actions taken and policies adopted by employers and government can have a variety of effects, from permanently reducing the severity and scope of the shortage to temporarily alleviating it for a particular geographic area or category. We will examine the extent to which many of these actions have been successful in the past and the lessons learned from them.

1. By Employers

Employers are the ones most immediately affected by the shortage; they cannot hire enough certified special education teachers, and as a result, they run the risk of being sanctioned for noncompliance with state and federal regulations and they expose themselves to litigation from watchful parents. For these reasons they are the ones most compelled to take action.

a. Use of Temporary Certification

The first and easiest thing for employers to do in the face of a shortage of fully-certified special education teachers is to hire individuals with temporary certification. These are often general education teachers working in the same school districts who have some desire to move into special education, and thus are transferred to special education classes. They may also be special education teachers who are certified in other states and are still unable to immediately obtain certification in the state where they are employed. According to those whom we interviewed, schools facing shortages often simply continue to hire these teachers and have them renew their certifications indefinitely. One official noted that between 2 and 20 percent of all special education teachers in her state were not fully-certified. One study states, "clearly it is the primary means of dealing with personnel shortages and, at the same time, meeting the mandate for services."[73]

States tacitly allow this "revolving door" policy because they have no alternative -- to not allow or to place limits on the recertification of temporary certificates might only result in exceptional children becoming more under-served. Temporary certification does not, however, generally affect the long-term shortage for certified teachers, but rather staves off the shortage for employers in the short term. One interviewee commented that this was simply a "band-aid" reaction to the shortage, and that it tended to be ineffective in dealing with the shortage in the long term.

b. More Aggressive Recruiting

As discussed earlier in this chapter, some school districts have also begun to aggressively recruit special education teachers on a national basis, both new entrants and those teaching in other states. In addition to pursuing traditional recruiting methods, some participate in electronic bulletin boards and employment clearinghouses, hire teacher "headhunting" firms to find special education teachers, and travel to universities and job fairs to attract promising applicants to their districts. In addition to improving their networks and vacancy announcements, employers sometimes offer promising applicants expense-paid trips to visit schools, assist in employment searches for spouses, and help to find affordable housing. Some particularly innovative programs have even advertised on television in an effort to attract the large pool of trained teachers who have left the profession.

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[73] McLaughlin (1986), p. 46.

The results of such efforts have evidently been effective in alleviating shortages for selected districts. Several districts in Florida, which have stepped up their recruiting efforts for special education teachers, have reported some success in alleviating shortages; one currently reports no shortage. A disadvantage of such policies, however, is that by reducing the shortage for one employer, aggressive recruiting tactics -- targeted at existing special education teachers -- only increase the shortage for other employers in other areas, offering a zero-sum solution.

c. Funding Teacher Training

Education officials whom we interviewed said that some schools have effectively dealt with shortages by funding special education training for general education teachers whom they currently employ. The advantages of such incentives are obvious: the investment made saves the school district subsequent recruiting costs, as they have a reasonable assurance that the teacher will return to work in the same district after completion of the training. The disadvantages, however, are that such a policy, as a method of alleviating serious shortages of teachers, is more expensive for employers than recruiting, and not immediate in its impact (i.e., the district would have to wait several years to get any return on that investment). This strategy is usually most effective for teachers who have completed some or most of the requirements for special education certification and for whom the investment in time and money is not great.

d. Offering Rotation into General Education

Another useful long-term strategy that schools are applying to reduce the attrition and burnout rates among special education teachers is to transfer special education teachers into general education every few years. This policy of offering a variety of teaching capacities is thought to lower the alienation that many special education teachers feel from the general teaching staff, and help "return a healthy perspective" to teachers who have been teaching special education for long periods. The disadvantage of such a strategy is that it actually increases the severity of the shortage in the short term, as qualified teachers temporarily exit special education to enter general education.

e. Signing Bonuses and Financial Incentives

One interviewee cited examples of employers who offer signing bonuses as high as $1,000 to qualified teachers willing to relocate to their school district. In addition, some employers offer to help pay a portion of teachers' educational loans (up to $10,000 over four years of employment). Our interviewees also cited examples of employers who offer wages at a higher level in the pay structure for some special education teachers, particularly those certified in areas of critical shortages such as severely emotionally handicapped and severe mental retardation; these salary-based incentives, however, are generally rare. Although such financial incentives are similar in many ways to wage increases (and in fact, they do increase the effective salary for the recipient), there are several notable differences: first, one-time bonuses are much less expensive for employers than permanent salary increases; second, they inspire less opposition from other teachers, who might have otherwise protested increases for a favored teaching specialty; and third, offering one-time bonuses is an easier practice to end once the shortage is over, and therefore have less of an effect on graduating students' decisions to enter the profession.

2. By Government

Governments, both at the state and federal level, have also taken steps to deal with shortages in special education. Government policies differ from those of employers in both intent and direction -- they are designed to alleviate the shortage on a broader scale rather than for a specific employer or geographic area. Government policies revolve around four basic goals: (1) to collect accurate information on the number of special education teachers available and the number of vacancies available; (2) to adjust key policy variables, such as recommended student-teacher ratios and certification requirements; (3) to provide funding to universities to expand special education programs and to employers to assist them in adhering to policy regulations; and finally, (4) to coordinate their policies and programs with those of other states, reducing the barriers to interstate mobility for special education teachers.

a. Improved Data Collection

A major government initiative, partly in response to the labor shortage in special education, is the move to improve the data on special education personnel and programs, and is currently being undertaken by the National Center for Education Statistics and the Office of Special Education Programs in the U.S. Department of Education. This attempt to obtain more accurate information on the number of special education teachers who are educated, trained, certified, and employed, as well as those employed with temporary certificates, is a necessary precursor to any effective policies implemented to alleviate the shortage. In an effort to focus on those who leave special education, government-funded research is also addressing the issues of burnout and other reasons for attrition.

b. Coordination of Special Education Programs

In an effort to lower the barriers that discourage special education teachers from moving between states, several state governments and government-funded programs are working towards the development of a single lexicon of categories in which special education teachers can be certified (allowing teachers to easily evaluate certification types between states) and the development of interstate reciprocity in special education certification, allowing teachers to migrate between states and immediately be qualified for certification. Such "portability" of special education certification on a national level has also been advocated, with arguments that it would both increase mobility of teachers to states most in need, as well as make special education teaching more attractive to prospective special education teachers and fully-certified special education teachers who have left the field. A number of states have already engaged in reciprocity agreements (seven Northeast states are currently participating), and all indications point toward increases in such agreements.

c. Expansion of Alternative Certification Programs

The final key response by state governments to the shortage of special education teachers is the expansion and acceptance of alternative certification programs for special education teaching. As discussed earlier, alternative certification revolves around a set of requirements for teachers and professionals who wish to enter special education teaching and have had no prior education or training in special education. Alternative education requirements allow relatively easy and rapid entrance into the profession and are thus expected to increase the supply of new entrants into special education. Twenty-four states currently have sponsored or planned alternative certification programs, and although there is no consensus on the overall quality of graduates that such programs produce, alternative certification appears to be a gaining credibility as an effective method of dealing with long-term shortages in the field.

F. Conclusions and Recommendations

1. Conclusions

As examined in this chapter, the market for special education teachers exemplifies many of the institutional rigidities and supply/demand dynamics described in Chapter 2 as influencing or characterizing occupational labor shortages. It is a market characterized by institutionally determined wages and employment demand, long and rigorous training requirements, large amounts of paperwork and regulation, and a stressful work environment. The consequence is that special education teaching has among the highest rates of attrition for teaching specialties, with many of those leaving the field entering general teaching. Special education teachers, of whom a greater proportion are women (as compared to general education teachers), are also less likely to be the primary wage earners in the household, and thus their migration patterns tend to be heavily influenced by their spouses, toward suburbs and middle-class urban environments and away from inner cities and rural areas. This has resulted in several states reporting surpluses in suburban areas and critical shortages in rural and inner city school districts. Finally, the persistence of geographic shortages in special education teaching is aggravated by the barriers to occupational mobility between states, caused by the differences in certification requirements.

Most of the researchers and government officials whom we interviewed emphasize that the shortage is caused and exacerbated by a host of factors, and that there is no single policy that will eliminate it; rather, they point to a number of key issues that need to be addressed, each of which would affect the severity or distribution of the shortage. Some of these recommendations, they noted, are currently being implemented. Several others are listed below.

2. Recommendations

a. Radical Overhaul of the Education System

The broadest prescription offered by several of those we interviewed was to effect "a radical shift" in the service delivery system -- that is, the method by which students are provided with special education services. Although the specific steps necessary were not spelled out, they made clear that such a change would involve both mainstream and special education, and would result in special education as the product of a closely knit network of parents, mainstream teachers, special education teachers, and school administrators, rather than that of policymakers and administrators alone.

b. Simplification of Regulations

Other broad changes suggested include limiting or reducing the legal and regulatory burdens placed on special education teachers. Although many restrictions and standards established for special education ensure adequate and appropriate teaching instruction for exceptional children, the overwhelming paperwork and constraints placed on special education teachers was cited as a major factor influencing attrition from the field and in reducing the time special education teachers spend teaching. One of the experts we interviewed, as well as an article on shortages of emotional/behavioral disorders teachers, suggests that a reduction in the mandated paperwork requirements for special education teachers would increase time spent teaching.[74] A reduction in the complexity and degree of regulation imposed upon special education teachers, they argue, may also encourage qualified teachers who have left the profession to return.

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[74] Paul Lauritzen (1990), pp. 14-15.

c. More Administrative Support for Special Education Teachers

Another important prescription relating to the administrative and regulatory requirements placed upon special education teachers was that schools and school districts (employers) provide special education teachers with administrative support specific to the needs and requirements of special education. These special education administrators must understand the regulatory and legal facets of special education, and must be able to reduce the burden that special education teachers face. The impact of this, several of our interviewees noted, might be a reduced rate of attrition due to burnout, and would allow teachers to focus on teaching exceptional children and not on adhering to regulatory requirements.

d. Integration of Special Education into Mainstream Education Training

Another more specific step that our interviewees suggested was to require some special education courses and training for all teachers. This would allow general education teachers to better identify and understand the special disabilities and challenges that some of their students face, as well as encourage more potential general education teachers to obtain certification in special education. In addition, such a shift would decrease the alienation felt by special education teachers from the general teaching faculty. The disadvantage of such a proposal, our interviewees pointed out, is that done to any substantial extent, such a program would increase the length and cost of teacher training and would certainly be met with opposition.

e. Increases in Wages

The suggestion that wages be raised in order to reduce the special education teacher shortage evoked a mixed response. Some of those we interviewed argued that attrition from the field was not in any significant way due to insufficient wages but to a host of other burdens and stresses. Others disagreed; they stated that teacher attrition to general education and the lack of teachers in rural and inner city areas might be reduced if special education teachers were paid compensating differentials relative to mainstream teachers. Furthermore, increasing wages would both attract more teachers into special education and would encourage special education teachers to remain in the field. Empirically, one official whom we interviewed cited several examples of counties successfully averting shortages by offering bonuses and other financial incentives. Moreover, one study attributed Alaska's virtual lack of a shortage and Wyoming's relatively mild shortage to the high salary level of Alaska and Wyoming teachers. All agreed, however, that implementation of salary differentials for special education teachers alone would be difficult, given the nature of the teacher salary determination process.

The labor market for special education teachers, although complicated by a variety of institutional and educational factors, displays many of the important characteristics found in occupations experiencing shortages. Although the shortage is expected to continue for the next several years, employers, universities, and the government have begun to address many of the issues discussed above, and it is through this process that a free and appropriate education for all exceptional children will be achieved.

CHAPTER 4

CASE STUDY OF HOME CARE WORKERS

A. Description of the Occupation

The home care worker[1] is a paraprofessional who provides assistance in and support with basic living in the home setting. The aide performs personal care and home management services that enable the elderly, ill, or disabled person to live at home instead of facing institutionalization. The responsibilities of a home care worker include three main areas: (1) housekeeping tasks such as cleaning, doing laundry, and purchasing and preparing food; (2) personal hygiene tasks including bathing, grooming, dressing, and assisting in ambulatory movement (e.g., moving from bed to chair); and (3) health-related tasks such as taking standard measurements (e.g., pulse), helping with exercises, and assisting with medication. The home care worker provides emotional support for the client, and is often responsible for keeping progress reports and notifying supervisors of any changes in the client's conditions.[2] In addition, the successful home care worker is a mature, caring individual in good physical condition who can perform effectively in a wide variety of situations.[3]

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[1] Both states and agencies use a number of different titles for home care workers, such as homemaker, home health aide, chore worker, home care aide, personal care worker, and home attendant; they all describe the same basic job. Sometimes "home health aides" are used to describe more skilled positions, and "homemakers" and "personal care attendants" refer to less skilled jobs. (It is important to note that all of the titles refer to jobs that require very little training and education.) The exact title used to describe a worker is usually a function of the source of funding. Throughout this paper we will use titles interchangeably; however, when information is presented from other sources, the terminology will be consistent with the original source.

[2] U.S. Department of Labor, Bureau of Labor Statistics (Apr. 1990). Occupational Outlook Handbook, 1990-91 Edition, pp. 313-14.

There are a number of reasons why home care is an interesting occupation to examine. First, the occupation is unique because each assignment is characterized almost entirely by the client. The location of the service is by definition the client's home, the types of services rendered (e.g., personal care, homemaking) are a function of the client's needs, and the length of time that services are provided depends upon the client's medical condition (e.g., short recovery from surgery, chronic condition). As a result, the work site, hours, and level and type of effort required vary dramatically by case. Second, the policies of various third-party payors (e.g., private health insurance and state and federal government programs) significantly affect the demand for home care services and the supply of home care workers.

1. The Home Care Industry

Home care services have been provided historically through informal (uncompensated) care delivered by friends or relatives, through welfare agencies that assisted in caring for young children and helping with homemaking tasks when mothers were sick, and through health agencies that supplemented their skilled nursing services.[4] A number of factors have been important in the evolution of the home care field including: (1) increases in the labor force participation of women, who were traditionally the primary informal caretakers; (2) changes in the demographic composition of the nation, characterized by individuals living longer and a rapid growth in the size of the elderly population; (3) increased emphasis on the ability of patients to heal better at home than in institutions; and perhaps most importantly, (4) changes in health care reimbursement policies and shifts to manage costs by providing care at the lowest level of intensity. The next two sections discuss the effects that payors and employers have had on the evolution of the home care industry.

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[3] Allen D. Spiegel (Apr. 1990). Home Health Care: Home Birthing to Hospice Care, National Health Publishing, pp. 502-3; and Occupational Outlook Handbook, pp. 313-14.

[4] U.S. Department of Health, Education, and Welfare, Office of Human Development, Administration on Aging (1977). Human Resources Issues in the Field of Aging: Homemaker-Home Health Aide Services. AoA Occasional Papers in Gerontology, p. 2.

2. Payors

Medicare and Medicaid legislation (Sections XVIII and XIX of the Social Security Act), originally passed in 1965, provides medical services for disabled adults and people over age 65 (Medicare) and for low-income persons (Medicaid). Under the 1965 laws, proprietary home health agencies were required to be licensed by the state to qualify for Medicare and Medicaid reimbursement. Sections XVIII and XIX of the Social Security Act offered a new source of home care funding and fostered a shift in the home care industry away from its original focus on family and child care toward care of the elderly. Home care also became oriented more toward personal care, because reimbursement was not offered for homemaking services.

a. Medicare

Medicare, which consists of hospital insurance (Part A) and supplementary medical insurance (Part B), covers home health aides assisting with meal preparation, exercise, personal care, and personal cleanliness, but does not cover meal delivery programs, housekeeping chores unrelated to patient care, transportation, or shopping.[5] To qualify for home care services under Medicare, a person must be homebound, have services prescribed by a physician, and need intermittent skilled nursing care or physical, speech, or occupational therapy.

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[5] Spiegel (1983), p. 295.

Originally, Part A of Medicare covered home health agency services after a period of hospitalization and required no cost sharing (with the beneficiary), whereas Part B covered home health agency services and required an annual deductible. The initial legislation in 1965 included a number of qualifications that beneficiaries had to meet in order to receive services under Medicare, and limited the number of days service could be provided. The Omnibus Budget Reconciliation Act (OBRA) of 1980 reduced barriers to the use of home health services by eliminating the 100-day visit limit, the requirement for a prior hospital stay of three days, the Part B deductible, and the requirement for proprietary agencies to be licensed by the state. (Medicare still requires agencies receiving Medicare reimbursement to be certified; this process is administered by the states but it is separate from state licensing procedures.) These changes in OBRA 1980 were instituted to make home care more attractive and more widely available to Medicare-eligible individuals. In 1985, the Health Care Financing Administration (HCFA) tried to contain costs by limiting the allowable cost per visit and the number and frequency of home health care visits.[6] Further restrictions on reimbursement were instituted in the mid-1980s when fiscal intermediaries (i.e., contractors who review and pay Medicare claims) were instructed to impose stricter interpretations of medical necessity, which resulted in increased claim denials. The Omnibus Budget Reconciliation Act of 1987 changed the requirements of the homemaker-home health aide occupation by instituting competency exams and/or training requirements for home health aides employed by Medicare-certified home health agencies. The specifics of OBRA 1987 legislation are discussed in Section B, Training and Recruitment of Home Care Workers.

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[6] Nancy M. Kane (1989). "The Home Care Crisis of the Nineties." The Gerontologist. Vol. 29, No. 1., p. 29.

In fiscal year 1989, total Medicare home health benefit payments for Part A and Part B totaled $2.6 billion for all types of services (i.e., skilled nursing, physical therapy, and home health aide). This was an 11 percent increase over fiscal year 1988 expenditures. In 1989, there were 1,172 visits per 1,000 Medicare enrollees and the average charge per visit was $69.[7]

b. Medicaid

Medicaid is a state-administered program that is linked to actual or potential recipients of cash assistance under the Aid to Families with Dependent Children (AFDC) and Supplemental Security Income (SSI) programs. Medicaid eligibility is extended to two main groups -- the categorically needy and the medically needy.[8] Included among the categorically needy are recipients of AFDC; former recipients of AFDC who have lost benefits due to increased income; certain pregnant women and children who meet AFDC income and resources requirements; and the aged, blind, and disabled who receive Federal SSI payments. Included in the medically needy are the individuals who fall into the covered categories (i.e., aged, blind, disabled, families with dependent children, and pregnant women and children) and whose income and resources are in excess of the standards for categorically needy coverage. Many of the persons who are medically needy become eligible for Medicaid only after they have reduced their incomes and/or resources --

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[7] Committee on Ways and Means, U.S. House of Representatives (June 5, 1990). Overview of Entitlement Programs, 1990 Green Book, p. 145.

[8] Overview of Entitlement Programs, pp. 1276-88.

this is known as "spending down." The eligibility requirements and the level of cash assistance granted vary by state.

There is no definition of Medicaid allowable home health services under federal law; however, all states must identify a minimum range of home health services in their State Medical Assistance Plans. Under OBRA 1980, Medicaid (like Medicare) removed its earlier requirements for proprietary organizations to be licensed by the states and its limits on the number of covered home health visits.

Under Medicaid, states share program costs with the federal government; the federal government usually pays the majority of those costs. Medicaid spending on home health care totaled $2.6 billion in fiscal year 1989 (a 28 percent increase from fiscal year 1988).[9] In general, most states spend very little of their Medicaid dollars on home health care -- the national average is 4.7 percent of all Medicaid funding. New York has the most extensive Medicaid home health care program, accounting for a little over half of all Medicaid home health expenditures in 1989. On average, 2.6 percent of all Medicaid recipients receive home health care services, with a national average expenditure of $4,200 per recipient.

c. Other Sources

There are a number of other government programs that fund home care, including Social Service Block Grants (Title XX of the Social Security Act) and the Older Americans Act.[10] There are also a number of non-government funding sources, which include charities and associations (e.g., United Way of America, American Medical Association, American National Red Cross, American Cancer Society), and commercial carriers of group health insurance (e.g., private indemnity plans and health maintenance organizations), as well as monies paid by self-pay clients. Changes in reimbursement policies and the services covered by state and federal programs, private indemnity insurance, and health maintenance organizations are driving factors in the evolution of the home care industry by increasing demand for and recognition of the home health care occupation.

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[9] Home Health Line (November 7, 1990). Vol. XV. pp. 413-14.

[10] Spiegel (1983), p. 295.

The Home Health Care Edition of the 1989 Marion Long Term Care Digest found that on average 56 percent of the 1988 revenues of home health care agencies are from Medicare. Other major payors consist of Medicaid (13.5 percent), private insurance other than a Health Maintenance Organization (9.6 percent), the patient or patient's family (9.2 percent), and state or local governments (7.1 percent). Others estimate that private pay clients account for about 30 percent of home care expenditures, and that third-party payors account for about 70 percent of agency revenues.[11] Many researchers note that each public program has different target populations, eligibility requirements, administrative procedures and agencies, methods of determining reimbursement, and reimbursement guidelines and ceilings, which result in problems due to fragmentation of the funding and delivery of services.[12] The current structure of public programs is largely a product of state and federal political processes and competing special interest groups (e.g., provider associations, union representatives, home care advocacy groups, consumer groups, legislators), and is not a coherent method of delivering home health care services.

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[11] Margaret MacAdam (Feb. 1990). "Leadership Roles in Home Care Personnel Issues: A Challenge for State Units on Aging," p. 1, 10.

[12] Charlene Harrington and Leslie Grant (1990). "The Delivery, Regulation, and Politics of Home Care: A California Case Study." The Gerontologist. Vol. 30, No. 4, p. 451.

3. Employers

As home care has gained acceptance, the home care industry has experienced large increases in the number and types of agencies providing home health services. The delivery system includes home health agencies (which usually take at least one of the following forms: government-owned, hospital-based, proprietary, proprietary not-for-profit, and visiting nurse association agencies), as well as self-employed aides. Significant increases in the number of proprietary agencies occurred in the early 1980s when state licensure requirements were eliminated from Medicare and Medicaid reimbursement policy.[13] This resulted in the creation of new home health agencies and the conversion of previously non-proprietary agencies to proprietary agencies. In 1982 there were 2,924 Medicare-certified agencies, 17 percent of which were proprietary. This number increased to 5,824 agencies in 1985, 30 percent of which were proprietary.[14] Some of these proprietary agencies have expanded geographically to become multi-state chains, taking advantage of the possible economies of scale in home health care delivery.[15]

One major difference between the agency types is the source of funding. According to the Home Health Care Edition of the 1989 Marion Long Term Care Digest, government-owned home health agencies are funded by higher than average levels of Medicaid and state and local government funds; hospital-based agencies receive higher than average levels of Medicare and health maintenance organization funding; proprietary agencies receive higher than average levels of private insurance (other than HMO) and self-pay funding; and not-for-profit and visiting nurse association agencies receive higher than average levels of Medicare, Medicaid, and health maintenance organization (HMO) funding.[16] The average rates charged for "home health aide" services (i.e., personal care, bathing, exercise, and assistance with ambulation) are highest in hospital-based agencies and lowest in government-owned and proprietary agencies.[17] However, average "homemaker" wages are higher in proprietary and government-owned agencies and lower in hospital-based, not-for-profit, and visiting nurse association agencies.[18] Many of the employment characteristics of a homemaker-home health aide's job are determined to a large extent by the type of employer and the clientele served.

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[13] Medicare certification, however, is still required.

[14] Kane (1989), pp. 24-25.

[15] Research on the financial condition and viability of proprietary providers can be found in Penny Feldman, Alice M. Sapienza, and Nancy M. Kane (1990). Who Cares for Them? Workers in the Home Care Industry. Greenwood Press, Chapter 5.

Many agencies are run like temporary employment agencies, where the majority of workers are employed on an hourly or part-time basis, and there are no guaranteed work hours. According to survey results published in the 1989 Marion Long Term Care Digest, proprietary agencies employed almost three times as many "home health aides" on a part-time basis (25.4) as they did on a full-time basis (8.9), and almost twice as many "homemakers" on a part-time basis (19.1) as on a full-time basis (10.4). On average, agencies employed 14.1 home health aides and 15.2 homemakers on a part-time basis, and 6.2 home health aides and 7.6 homemakers on a full-time basis.[19]

While there are a number of problems for home care workers employed by agencies, such as a lack of benefits and guaranteed hours, these issues are exacerbated when an aide is self-employed. Many states (approximately 31) reimburse independent workers who are hired directly by the elderly or their families.[20] Self-employed workers are less likely than aides employed by agencies to receive fringe benefits, supervision (beyond that of the client), or training, and are more limited in their ability to find full-time work because there are no formal mechanisms for them to obtain new clients.

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[16] 1989 Marion Long Term Care Digest, p. 26.

[17] 1989 Marion Long Term Care Digest, p. 28.

[18] 1989 Marion Long Term Care Digest, p. 30.

[19] 1989 Marion Long Term Care Digest, p. 20.

The distinction between home care and other occupations delivering services in the home, such as maids and domestics, is sometimes blurred. There are also a number of similar paraprofessional occupations that involve both personal contact and helping or instructing others in an institutional setting. Examples of such occupations include attendants in children's institutions, nursery school attendants, nursing aides, occupational and physical therapy aides, and orderlies.[21] These institutional jobs usually pay higher salaries and offer more stable work environments than home care. However, home care jobs offer a significant amount of autonomy and responsibility that is not available in institutional-oriented occupations.

Other unskilled, nonsupervisory positions that are similar to home care include hotel workers, laundry/cleaning workers, beauty shop assistants, and grocery store workers. In these paraprofessional-level occupations, wages are usually higher than those of home care workers, and average weekly hours are at least as high as home care workers.[22]

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[20] MacAdam (1990), p. 10.

[21] Occupational Outlook Handbook, p. 315.

[22] Kane (1989), p. 29.

B. Training and Recruitment of Home Care Workers

This section addresses the training requirements for home health aides, the factors influencing those requirements, and the methods employers adopt when hiring home health aides.

1. Training Requirements

Although the minimum educational requirements for the home care field are the ability to read and write English, the training requirements for home health aides have been undergoing review and change. In the past, workers received training because the agency that employed them provided it voluntarily, or because state-imposed standards required it. However, not all states had training requirements, and the states that did have standards varied in their requirements (e.g., requirements ranged from 0 to 120 hours of training). Until recently, no federal standards were in place. Studies and media publicity concerning the home health care industry in the mid-1980s highlighted its rapid growth and unregulated atmosphere, and spurred congressional committees to investigate the industry. The Inspector General of the U.S. Department of Health and Human Services (DHHS) recommended that HCFA implement federal training standards for homemaker-home health aides receiving Medicare reimbursement for their services.

OBRA 1987 establishes qualifications for home care workers who provide services for Medicare-certified home health agencies. Certified agencies cannot use home health aides for Medicare patients on or after August 14, 1990, unless (1) the individual completes a training program and competency evaluation program, or passes a competency evaluation program without training; and (2) the individual is competent to furnish home health services. In other words, the training component is not necessary if a home care worker can pass a competency exam without it. The training and competency evaluation programs must meet the minimum standards established by the Secretary of Health and Human Services.[23] A more detailed description of the training program requirements is provided in Exhibit 4.1. Training is to be a minimum of 75 hours, with at least 16 hours of classroom training, followed by at least 16 hours of supervised practical skills. The 75-hour standard was adopted by HCFA to reflect current statutory requirements for nurse aides in Medicare and Medicaid certified nursing facilities; HCFA believes that home health aides should acquire the same amount of training as nurse aides.[24] There are also specific requirements regarding "authorized" instructors and training content. OBRA 1987 outlines 12 specific items that must be covered during training, the majority of which are health-related; HCFA believes these approximate current industry standards because HCFA used a composite of the training standards detailed by the Joint Commission for Accreditation of Health Organizations, the model curriculum of the Foundation for Hospice and Homecare,[25] and the National League for Nursing. Training programs may be offered by a variety of sources including the employing

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[23] Federal Register. Vol. 54, No. 155. Monday, August 14, 1989, p. 33357. The January 1, 1990, deadline discussed in this notice was later extended to August 14, 1990.

[24] Federal Register. August 14, 1989, pp. 33357-8.

[25] The Foundation for Hospice and Homecare has developed "A Model Curriculum and Teaching Guide for the Instruction of the Homemaker-Home Health Aide." The model curriculum was originally developed by the National Home Caring Council in 1978 with funding from the U.S. Public Health Service. The Foundation has recently received funding from the Administration on Aging to update the model curriculum and design a national certification program that includes training materials and a two-part competency test. Organizations like the Foundation have been making strides in defining and molding the training and testing used in conjunction with the quality assurance provisions in Medicare legislation.

Exhibit 4.1: OBRA 1987 Requirements for Home Health Aides Employed by Medicare-Certified Home Health Agencies

TRAINING

(Training is not required if competency is demonstrated.)

A. Hours	Minimum of 75 hours -- at least 16 hours supervised practical skills and at least 16 hours of classroom training before practical skills training. Training must be with individual (not a mannequin) but not necessarily with a patient. Training can be done in classroom/laboratory setting.
B. Instructor	Training under supervision of RN with at least two years experience -- at least one year in home care and at least six months supervising home health aides.
C. Content	1. Communication skills 2. Observation, reporting, and documentation of patient status and care or service given 3. Reading and recording temperature, pulse, and respiration 4. Basic infection control procedures 5. Basic elements of body functioning and changes in body function that must be reported to the supervisor 6. Maintenance of a clean, safe, and healthy environment 7. Physical, emotional, and developmental characteristics of the populations served by the home health agency, including the need for respect for the patient, his/her privacy, and his/her property 8. Appropriate and safe techniques in personal hygiene and grooming that include bed bath; sponge, tub or shower bath; shampoo in sink, tub, or bath; nail and skin care; oral hygiene; toileting 9. Safe transfer techniques and ambulation 10. Normal range of motion and positioning 11. Adequate nutrition and fluid intake 12. Any other task that the home health agency may choose to have the employee perform.

Exhibit 4.1 (Continued): OBRA 1987 Requirements for Home Health Aides Employed by Medicare-Certified Home Health Agencies

COMPETENCY EVALUATION

(Competency must be demonstrated in selected basic skill and knowledge areas.)

A.	Competency Evaluated by Direct Observation	Competency must be demonstrated in the following areas while under direct supervision of qualified RN: ● Reading and recording temperature, pulse, and respiration ● Personal hygiene that include bed bath; sponge, tub or shower bath; shampoo in sink, tub, or bath; nail and skin care; oral hygiene; toileting ● Safe transfer techniques and ambulation ● Normal range of motion and positioning
B.	Competency Evaluation of Basic Knowledge	Home health aides must also demonstrate competence in the following areas (methods may be written, oral, or by observation) ● Observation, reporting, and documentation of patient status and care or service given ● Basic infection control procedures ● Basic elements of body functioning and changes in body function that must be reported to the supervisor ● Maintenance of a clean, safe, and healthy environment ● Physical, emotional, and developmental characteristics of the populations served by the home health agency, including the need for respect for the patient, his/her privacy, and his/her property ● Adequate nutrition and fluid intake ● Any other task that the home health agency may choose to have the employee perform.
C.	Duration	Yearly evaluations and quarterly in-service training are also required. If a home health aide has not worked for 24 consecutive months, retesting of competency is required.

Source: Joan Wolff (April 1990). "Training and Certification of Homemaker-Home Health Aides." CARING Magazine. Vol. IX, No. 4, pp. 34-35.

agencies, community colleges, and the American Red Cross.[26]

A detailed description of the competency evaluation is also provided in Exhibit 4.1. All home health aides had to pass a competency exam by August 14, 1990, to serve Medicare patients. By this date, agencies had to begin (1) conducting performance evaluations of each homemaker-home health aide at least once every 12 months, and (2) providing at least three hours of in-service training per calendar quarter. The requirements for participation by home health agencies in the Medicare program are described in a HCFA interim final rule.[27] This rule requires home health agencies to maintain documentation proving that the training and competency evaluation requirements are met. This documentation will be used by the Medicare state surveyor to determine if the home health aides used by each home health agency meet the regulation's requirements.

The people we interviewed are supportive of the recent OBRA legislation and believe that significant strides are being made to increase the standards and quality of home health care. They are very concerned, however, about the status of care delivered to non-Medicare clients. The non-Medicare portion remains unregulated by the federal government, and aides are usually not required to be trained or to pass competency standards. Most of those we interviewed advocate training for all home care workers, including those serving non-Medicare clients. Training is generally viewed as the best way to establish minimum quality standards for home care aides.

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[26] There are some conditions under which a Medicare certified agency cannot conduct training or competency evaluation programs. These were originally established in conjunction with OBRA 1987, and revised in OBRA 1990.

[27] Federal Register. Monday, August 14, 1989, p. 33359.

2. Methods Employers Use to Recruit Home Care Workers

Word-of-mouth is the most frequent method used by agencies to recruit home care workers. While there is no national information available, anecdotal evidence, as well as a New York state survey, suggest that the majority of all home care workers heard about their jobs through word-of-mouth -- often from friends within the home care occupation.[28] Home care workers (i.e., current workers, new workers, and workers who have left the field) were asked how they heard about their jobs; they could respond by listing one or more sources. Of all workers, 54 percent heard about the job through a friend or relative in home care, 21 percent through a friend or relative not in home care, 24 percent in a newspaper advertisement, and 12 percent by a person who needed home care. Other sources which workers listed much less frequently included advertisements in subways or buses, advertisements on television, community groups, employment offices, churches/ministers, and welfare departments. Workers who had left home care were more likely than current workers to cite newspaper, subway, or bus advertisements; employment offices; and relatives or friends in the home care field as a source. In suburban areas, advertisements in newspapers were cited significantly more often than in New York City.

According to the literature and the experts we interviewed, recruitment of home care workers is a major problem. However, the employers we spoke with did not use aggressive or innovative recruiting techniques. One agency encourages word-of-mouth recruitment by offering bonuses to employees who are able to bring in friends or relatives as new employees. Some other agencies run advertisements in weeklies and free local papers, instead of keeping the same advertisement in a daily newspaper for a number of weeks.[29]

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[28] Long Term Care Policy Coordinating Council, the Office of Program Planning Analysis and Development, and the Division of Medical Assistance, New York State Department of Social Services (Jan. 1990). Strengthening the Home Care Work Force in New York State: A Study of Worker Characteristics, Recruitment, and Retention, p. 13.

3. Characteristics of Workers in the Occupation

While national statistics on the demographic characteristics of home health aides are not available, some information has been published. Exhibit 4.2 highlights some of the characteristics of workers based on a number of surveys that have been conducted. Home care workers are usually women, approximately 45 years old, with limited formal education and skills. National studies indicate that about half of all home care workers are minorities, and that approximately 60 percent of home care workers are heads of households.[30]

Many of the employers we interviewed confirm the above statistics. Some anecdotal evidence suggests that there have been minor changes in the demographic characteristics of workers over time. One interviewee believes that on average current workers are younger and less experienced as homemakers than workers in the past. They suggest that in the late 1960s and 1970s a large pool of older women who had finished raising their children and desired part-time jobs became home health aides. However, with these women leaving the field and with the labor force participation of women increasing,

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[29] There have been limited state programs aimed at recruiting home care workers, such as a New Jersey State Department of Health program aimed specifically at training seniors (over age 50) to become homemaker-home health aides in response to increases in need. Information on this program is available in Diedre D. Fisher and Rickey Greene (May 1988). "Training Seniors as Homemaker-Home Health Aides." CARING Magazine. Vol. VII, No. 3, pp. 11-15.

[30] See Barnow, Burt, et al. (Aug. 1988). The Home Care Labor Market in New York State: An Analysis of the Issues and Projections through 2000, p. 5-5.

Exhibit 4.2: Home Care Worker Characteristics from Local, State, and Multi-State Surveys

	Farnsworth Study 1989	Mass Rate Setting Comm 1987	Multi-State Survey Feldman et al. 1987
Sample Size	40	1181	1284
Average Age	50	45	45
Percent Female	95%	NA	98%
Percent Married	41%	NA	42%
Education			
Less than High School	47%	NA	39%
High School Graduate	42%	72%	61%
More than High School	11%	NA	NA
Average Time on Job (years)	3.7	3.9	3
Current Wage (average)	$6.42	NA	$4.31
Average Hours per Week			
<= 15 Hours	47%	NA	NA
16-23 Hours	32%	NA	54%
24-32 Hours	21%	NA	NA
35+ Hours	0%	NA	46%
Access to a Car	18%	NA	49%

Notes: The Farnsworth Study looks at characteristics of 40 randomly selected homemakers at a private proprietary homemaker agency, Homemaker Services, Inc. The multi-state survey of home care workers is discussed in: Penny Feldman, Alice Sapienza, and Nancy Kane. Who Cares for Them? Workers in the Home Care Industry. Greenwood Press, 1990.

Source: Margaret MacAdams. "Leadership Roles in Home Care Personnel Issues: A Challenge for State Units on Aging." National Aging Resource Center: Long Term Care. Brandeis University. February 1990, p. 13.

new entrants are more likely to be younger.

C. Employment and Earnings of Home Care Workers

National statistics on employment and earnings for home care workers are difficult to obtain. Information on the home care occupation can be obtained from the Current Population Survey (CPS), but the CPS data have a number of limitations. Problems exist in the CPS data due to different job titles and service definitions, and difficulty discerning which aides work in institutions and which work in the home setting. There are also difficulties identifying independent, self-employed home health aides. The Bureau of Labor Statistics (BLS) does not regularly publish data on home care workers; therefore, time series data are unavailable. When figures are published, they must be interpreted with caution, taking into account which home care aides are being identified. This section draws upon published employment and earnings surveys and projections.

1. Employment Trends

The U.S. Bureau of the Census counted 350,000 "health aides -- except nursing" in 1985; this figure is an overestimate because it includes some aides who were working in institutional settings. In 1986, BLS estimated that 213,000 "homemaker-home health and nursing aides" worked in private households for organized employers; however, this figure is an underestimate because it does not include independent workers, who constitute a significant portion of the home care workforce. A telephone survey of states with individual provider programs estimated that 145,000 workers served as individual providers in 1986.[31] A realistic estimate of the home care workforce in 1986 is about

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[31] Feldman, (1990), p. 8.

350,000 workers, based on the combination of BLS data and the survey identifying individual providers. The National Association for Home Care estimates that there were between 300,000 and 500,000 homemaker-home health aides in 1986; however this estimate is based on "impressions," not rigorous surveys or research.[32]

BLS estimates that 236,000 "home health aides" were employed in 1988, and that the number of home health aides will grow to 397,000 by the year 2000 under moderate growth assumptions. (This estimate is low because it does not include self-employed aides.) This increase of 160,000 jobs translates into 68 percent job growth between 1988 and 2000, and BLS projects home health aides to be the third fastest growing occupation in the United States.[33] BLS states there will be a "great demand to serve the needs of the increasing population who are aged and ill but live at home."[34] Because of this rapid growth, new jobs may grow faster than the supply of home care workers, leading to potential shortages.

It is important to note that the increases in employment that are projected by BLS are not the sole source of job openings -- they only represent new jobs. There are extremely high turnover rates among home health workers, and the positions created when workers leave will also need to be filled. However, these are not all new workers because many aides remain in the home care field and migrate to different agencies. Exact turnover data are difficult to obtain because of the lack of research in the area and conflicting definitions and computations of turnover statistics. Estimates suggest that the industry average annual turnover for "home aides" is 60 percent for one year and 80 to 90 percent for two years.[35] The 1989 Marion Long Term Care Digest estimates that annual turnover is 25 percent for "home health aides" and 40 percent for "homemakers."[36] Because home care workers receive little formal training, high turnover rates are less disruptive than they would be in an industry relying heavily on permanent, full-time labor. Still, high turnover creates additional costs in the form of worker recruitment, training, and orientation expenses; decreased productivity; and declines in continuity of care, client satisfaction, and quality.[37]

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[32] See Feldman (1990), pp. 7-8; MacAdam (1989), p. 3.; and George Silvestri and John Lukasiewicz (April 1990). "Projection of Occupational Employment, 1988-2000." Outlook 2000. U.S. Department of Labor, Bureau of Labor Statistics, p. 54.

[33] BLS estimates that there were 327,000 "homemaker-home health aides" employed in 1988, and that the number of homemaker-home health aides will grow to 535,000 by the year 2000. This is an increase of 208,000 jobs, which translates into 64 percent growth between 1988 and 2000.

[34] Silvestri and Lukasiewicz (1990), p. 49.

There are also high vacancy rates among home health care jobs. Our interviews indicate that many agencies have home care positions available which they are unable to fill. Researchers note that the once plentiful pool of workers available for home care jobs has diminished, with many paraprofessional positions available and no workers applying to fill them.[38] The 1989 Marion Long Term Care Digest notes that home health aides have the highest vacancy rates of all positions employed by home health agencies, with an average vacancy rate of 4.5 percent.[39]

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[35] Feldman (1990), p. 11.

[36] 1989 Marion Long Term Care Digest, p. 21. Turnover is based on the percentage of workers who have left each job in the last 12 months.

[37] Feldman (1990), p. 11.

[38] Human Resources Issues in the Field of Aging: Homemaker-Home Health Aide Services, p. 2; and Nola Alberts (May 1988). "The Outlook for Home Health Paraprofessionals." CARING Magazine, pp. 20-22.

[39] 1989 Marion Long Term Care Digest, p. 21. Vacancy rates are based on the percentage of positions that were unfilled at the time of the survey.

The actual number of new positions created within home health care depends on a variety of market factors, such as:

- **Changing Demographics.** The growth in the elderly segment of the population who are most in need of home care.
- **Changing Technology and Health Care Strategies.** Increasing reliance of the health care industry on home care as opposed to institutional care, due to portable equipment and the belief that the home is often a more effective mode of treatment.
- **Funding.** The availability of public and private funds to purchase home care services.
- **Reimbursement Policies.** Increases in health care costs create pressure by insurance companies to decrease hospital lengths of stay. Patients are discharged from an institutional setting and to a home setting much earlier, and many are unable to take care of themselves. Medicare, Medicaid, and other provider policies have a significant effect on the demand for services, as occurred under OBRA 1980.

These issues are addressed in more detail in Section D of this chapter.

2. Earnings Trends

Because third-party payors provide approximately 70 percent of agency revenues and set limits on the level of reimbursement, home care workers face a labor market in which wages do not move freely.[40] The remaining 30 percent of revenues come from self-paying elderly clients, who are often on fixed incomes and are extremely limited in their ability to pay for care. As a result, wages are often inflexible, particularly for workers in agencies reimbursed by federal and state programs such as Medicare and Medicaid. Fixed budget programs must often reduce the number of hours of service provided when costs (wages) rise. In addition, reimbursement systems usually have payment mechanisms designed to keep costs low. For example, current Medicare regulations restrict reimbursement based on an agency's historical costs.[41] Employers are unwilling to pay workers more than the amount insurance payors are willing to compensate the agency. Many states use contract bidding procedures which award the provision of care to the home health agency with the lowest possible costs. This practice encourages agencies to provide the minimum level of wages, fringe benefits, training, and supervision -- bringing into question the quality of home health care provided through the competitive bidding process.[42]

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[40] MacAdam (1990), p. 10.

Trends on earnings are not available for homemaker-home health aides; however, surveys indicate that the average national wage is between $4.50 and $5.00 per hour.[43] Because home care is a low-skill occupation, wages are sensitive to the minimum wage; in fact, many state rate-setting commissions set the home care wage at the minimum wage.[44] The increase in the federal hourly minimum wage from $3.80 to $4.25 on April 1, 1991, should slightly better the financial position of a number of home care workers. (A lower training wage can be paid for up to six months to workers who are under 20 years of age.) Home care workers' earnings vary by geographic location, insurance coverage, type of client served, and experience (to a limited extent). Many experts stress that employers cannot realistically raise wages because of current state and federal reimbursement policies (as well as private health insurance reimbursement levels), and that poorly paid home care workers in effect subsidize the cost of home care.[45]

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[41] MacAdam (1990), p. 11.

[42] MacAdam (1990), p. 11.

[43] Estimates include $4.41 from Burt Barnow, et al., (1988), p. 5-5.; $5.13 from the 1989 Marion Long Term Care Digest; $4.00 to $4.50 from Rick Surpin (Apr. 1988). "Current Status of Paraprofessionals in Home Care." CARING Magazine, p. 4; $4.50 to $5.00 from Mary Koska (May 5, 1988). "Alternate Care: Aide Shortage Limits Home Health Care Delivery." Hospitals, p. 63; and $4.31 from a multi-state survey in Feldman (1990), p. 25.

[44] Kane (1989), p. 29.

D. Factors Contributing to a Shortage

1. Presence of a Shortage

Most of the available home care literature, as well as many of the persons we interviewed, assert that there is a national shortage of home care workers. One expert maintains that while there may not be a shortage in the strictest economic sense, the poor quality of many workers suggests that having people to fill jobs does not necessarily mean the supply of home care workers is appropriate (i.e., some of the current home care workers are not appropriately qualified to provide the necessary standard of care). Most define the home care shortage as having health care authorized and funded, but not being able to provide the necessary home care services. In other words, the demand for care cannot be met by the current supply of home care workers at the available wage rate.

The multitude of reports by states and home care agencies highlighting their recruitment and retention problems and their inability to provide authorized care indicate that there are at least short-term shortages in the home care labor market in many areas of the country.[46] Serious problems in recruiting and retaining workers have been noted across the nation, especially in rural states, on the West Coast, in the Great Lakes states, and in states with low unemployment rates. Preliminary findings from a national study of 25 home health agencies indicate that 85 percent of agencies reported major problems in recruiting and retaining aides at existing wage levels.[47] In a survey by the National Association for Home Care, 48 percent of the agencies that responded had problems recruiting and retaining workers; many of these respondents emphasized that reimbursement levels were too low to attract workers.[48] While areas with high concentrations of immigrants have less of a problem, rural, depressed states and areas with large growth in public funding for home care services report severe shortages.[49] Many states indicate that the elderly must wait weeks or even months for care, and our interviews with employing agencies indicate that wait-listing clients, turning down clients, and providing only part of the total authorized services are common occurrences that result from open home care positions that cannot be filled.

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[45] In other words, because home care workers receive such low wages and benefits, it is argued that, in effect, they provide a subsidy that allows reimbursement of home care services by payors to be at such a low cost. This was mentioned in our interviews; in Kane (1989), p. 30; and in Rick Surpin, "Improved Working Conditions Lead to Improved Quality." CARING Magazine, p. 26.

[46] For example, the Massachusetts Rate Setting Commission estimated a 20 percent gap between hours of service authorized and hours actually provided by state health care agencies in 1986.

Almost all of the experts we interviewed believe that there is a labor shortage of home health care workers (at current wage levels) in certain areas of the country. While the home care shortage does not appear "severe," it does result in the denial or delay of necessary care, reductions in the level of home care services a client receives, and diminished quality of care. A shortage of workers in any health field is particularly disturbing because it jeopardizes the health, quality of life, and well-being of the individuals who are affected. In the case of home care, this is primarily the elderly. The next two sections discuss the factors influencing the demand and supply of home care workers.

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[47] MacAdam (1990), p. 4.

[48] Patricia Jones (May 1988). "The Home Care Personnel Shortage Crisis: Preliminary Results of a NAHC Survey." CARING Magazine, p. 6.

[49] MacAdam (1990), p. 4.

2. Demand-Side Factors

Important factors that influence the demand for home care workers include the size and composition of the elderly population; trends in informal home care; cost containment policies; changes in program eligibility and the services provided (e.g., Medicare); and the availability of nursing home beds.[50]

a. Size of the Elderly Population

The size of the elderly segment of the population is projected to grow rapidly between now and the year 2000. Estimates suggest that 71 percent of care provided by home health agencies is delivered to senior citizens.[51] Additionally, about 20 percent of all persons in the United States age 75 and over, and 7 percent of persons age 65 to 74, are expected to use home care services each year.[52] The U.S. population is expected to grow by 0.7 percent annually between 1988 and 2000, but the segment of the population between 75 and 84 is projected to grow 2 percent annually, and the segment age 85 and over is expected to grow at 3.8 percent annually.[53] Because the use of home health care services is significantly correlated with age and the size of the elderly population, demand for home health care services should increase.

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[50] The majority of this discussion is from Barnow (1988), Chapter 4.

[51] 1989 Marion Long Term Care Digest, p. 13. This estimate of patient mix includes all home health agency services (e.g., skilled nursing, medical services, home infusion therapy, respiratory services, housekeeping, personal care, etc.), not just personal and homemaking services.

[52] See Alice M. Rivlin and Joshua M. Wiener (1988). Caring for the Disabled Elderly -- Who Will Pay?. Washington, D.C.: The Brookings Institution, p. 6.

[53] Howard Fullerton (Apr. 1990). "New Labor Force Projections, Spanning 1988 to 2000," Outlook 2000. Bureau of Labor Statistics, U.S. Department of Labor, pp. 2-3.

b. Trend in Informal Home Care

The trend in informal home care is another factor that influences the demand for home care workers. Decreases in the availability of informal family care result from (1) a higher ratio of elderly parents to children due to increased life expectancy, delayed marriage, and declines in fertility; (2) an increasing number of widowed elderly women without spouses to care for them due to differences in the life spans of the sexes; and (3) a decreasing number of women who are able and willing to take responsibility for care of friends and relatives due to increases in female labor participation rates.[54]

c. Cost Containment Policies

Large increases in health care costs for acute and long-term care have prompted the adoption of cost containment policies by payors (e.g., Medicare, Medicaid, private health insurance, HMOs). Medicare increased its funding of home care in the early 1980s, believing that home care was a more cost-effective mode of treatment than institutional care; however, this resulted in large increases in expenditures. Medicare's adoption of the Prospective Payment System (PPS) and its use of Diagnostic-Related Groups (DRGs) for hospitals created an incentive to decrease hospital lengths of stay because providers are reimbursed on a fixed amount per diagnosis, not on an individual patient's condition and length of stay. As a result, patients are discharged from an institutional setting and to the home setting much earlier, with many unable to take care of themselves. This shift of health care to a less intense setting (from hospital to home) creates a greater demand for home health services in the form of longer and more frequent visits, as well as more skilled care.

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[54] Feldman (1990), pp. 5-6.

d. Changes in Eligibility and Services Covered

Changes in program eligibility and the services provided, especially in federal programs, have a significant impact on the demand for home care services. Changes in the Social Security Act during the early 1980s decreased the barriers to home care use under the Medicare program and resulted in increases in the amount of care provided at home. Medicare expenditures on home health benefits grew from $726 million in 1980 (before implementation of OBRA 1980) to $2.2 billion in 1985.[55] In addition, Medicare-certified agency users increased from 35 per 1,000 Medicare enrollees in 1981 to 51 per 1,000 Medicare enrollees in 1985, while skilled nursing facility users remained constant.[56] Any future long-term care policy changes with regard to eligibility and allowed services will also affect the demand for home care.

e. Availability of Nursing Home Beds

Although there has been an overall trend toward home care and away from institutional care, the availability of nursing home beds will affect the demand for care in the home. Nursing home and home care services are seen as "substitutable," and as changes in the need for long-term care arise, there will be an interaction between these two settings. In many states a Certificate of Need (CON) is necessary for institutions to increase the number of nursing home beds. If the supply of beds is unable to keep up with the demand for long-term care, due to either difficulty in obtaining a CON or lack of appropriate capital investment, home care is likely to take up the extra slack.

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[55] Overview of Entitlement Programs, pp. 144-45.

[56] Marian Gornick and Margaret Hall (1988). "Trends in Medicare Use of Post-Hospital Care." Health Care Financing Review, 1988 Annual Supplement, p. 31.

3. Supply-Side Factors

There are several agency and worker surveys that identify major home health care labor supply issues:

- The National Association for Home Care (NAHC) conducted a national survey of home care agencies in 1988, and asked what was the single most important factor contributing to the homemaker and home health aide shortage. Exhibit 4.3 details the results available from the respondents.[57] Low wages and poor benefits are two of the most noted problems. Other important issues include transportation problems, lack of advancement, poor role image, and inadequate training.

- There is potentially relevant information in the results of a New York state survey that studied worker characteristics, recruitment, and retention.[58] While it is a state-specific survey, some of the results are applicable to the nation.[59] Both current workers and workers who had left the home care field were administered a perception-oriented survey. Only 26 percent agreed that the pay was good, 24 percent agreed that the fringe benefits were good, and 23 percent agreed that chances for promotion were good. Even though 93 percent of the workers got a sense of accomplishment out of their jobs, the majority would not characterize their current home care job as being financially rewarding or offering good chances for improvement. Another set of questions was asked of former workers regarding the reasons they left the home care field. Exhibit 4.4 provides a summary of the questions and response rates. Frequently mentioned reasons for leaving the field included low wages, lack of advancement potential, poor benefits, and unstable hours.

- A multi-state survey that was presented in Who Cares for Them? Workers in the Home Care Industry focused on home care workers' attitudes toward their job. Home care workers were asked to rate aspects of their jobs based on a five-point scale of their level of satisfaction (very satisfied, slightly satisfied, not satisfied nor dissatisfied, slightly dissatisfied, and very dissatisfied). Exhibit 4.5 shows that workers were most dissatisfied with pay and benefit issues, their opportunity to advance, and the number of

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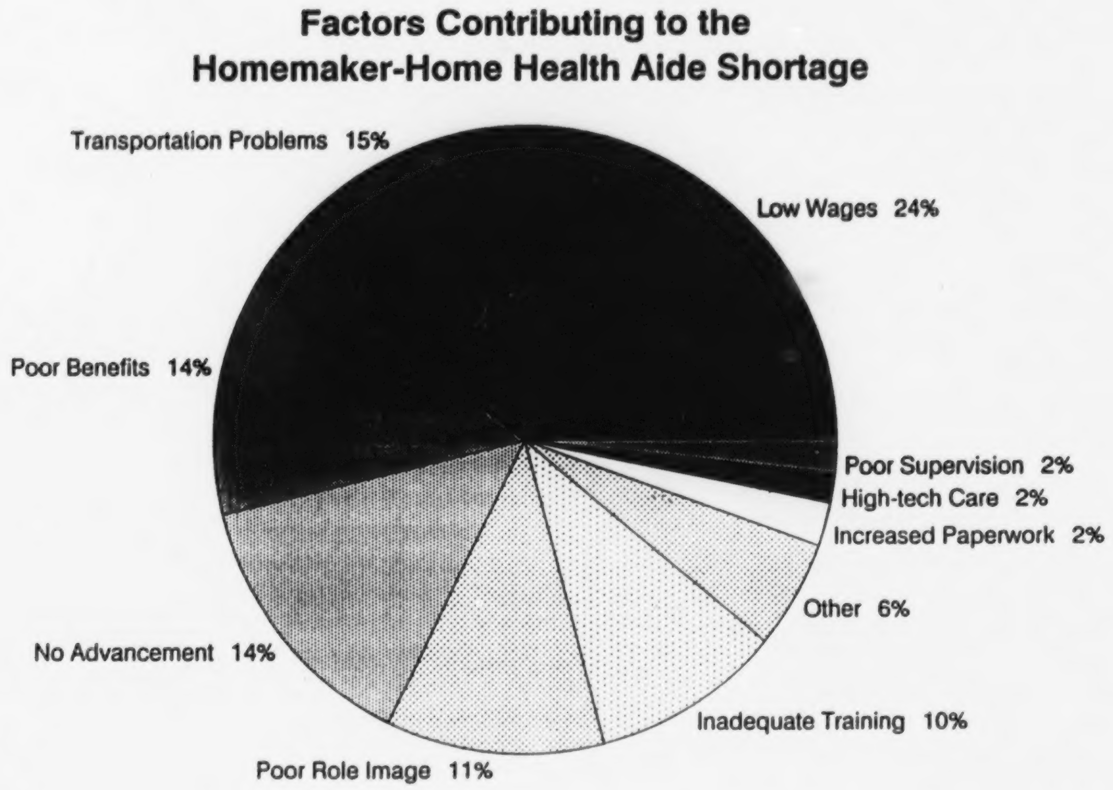
[57] Jones (1988), p. 8. The survey went to 2,197 NAHC member agencies, over 1,000 replied, and 841 were acceptable for data analysis.

[58] Long Term Care Policy Coordinating Council (1990).

[59] There are many unique features that characterize the New York home health care market; these include the high concentration of immigrants and minorities in the home health field, the large amounts of Medicaid spending on home care in New York, and the diversity of the populations in New York City and outlying counties. See Barnow (1988).

Exhibit 4.3: Factors Contributing to the Homemaker-Home Health Aide Shortage


Factors Contributing to the Homemaker-Home Health Aide Shortage

Source: Jones, Patricia. "The Home Care Personnel Shortage Crisis: Preliminary Results of a NAHC Survey." CARING Magazine, May 1988.

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Exhibit 4.4: Reasons Former Workers Left Home Care in New York

Percent of Former Workers Who Indicated That One Reason For Leaving Their Last Home Care Job Was...	Percent
Wage too low	53.0
No advancement potential	27.8
No medical plan	26.8
Inadequate vacation/sick days	25.4
Wanted weekends off	26.4
Not enough hours	20.2
Number of hours irregular	20.2
Client lived in unsafe neighborhood	13.0
Client died	12.9
Lost work hours/client hospitalized	12.6
Client was too much trouble	11.9
Too much time to get to clients	11.1
Inadequate training	11.8
Too much carfare to get to clients	11.4
Living conditions in client's home was unsanitary	10.4
(sample size=336)	

Source: New York State Long Term Care Policy Coordinating Council, Survey of Home Care Workers. Strengthening the Home Care Work Force in New York State: A Study of Worker Characteristics, Recruitment, and Retention. January 1990.

Exhibit 4.5: Home Care Worker Attitudes Toward the Job

Aspect	Satisfied	Dissatisfied
Pay	35%	51%
Benefits	34%	52%
Pay/Benefits Construct	24%	55%
Opportunity to Advance	44%	34%
Hours Worked	69%	21%
Training Adequacy	81%	13%
Isolation	74%	16%
Opportunity to Help	93%	3%
Treatment by Supervisor	86%	7%
Treatment by Company	78%	11%
Intrinsic Job Satisfaction	68%	11%
Overall Job Satisfaction	84%	9%
Will look for New Job		18%

Source: Penny Feldman, Alice Sapienza, and Nancy Kane. Who Cares for Them? Workers in the Home Care Industry. Greenwood Press, 1990.

> hours worked. Overall, home care workers were satisfied with their jobs; they were most satisfied with the opportunity to help others, the treatment they received from their supervisor and company, and the adequacy of training they received.[60]

The following supply factors were noted repeatedly in our interviews and in the literature as being important: ability of agencies to provide stable work environments, wage rates and fringe benefits available to home care workers compared to other options, transportation and travel policies, job status and recognition of home care paraprofessionals, advancement opportunities for home care workers, training for home care workers, clear definitions and responsibilities for various types of home care workers, and the size of the relevant labor pool of workers. In general, these items are barriers to entry in the occupation, reasons for the high turnover within the occupation, or both.

a. Unstable Work Environment

Home health care workers face an extremely unstable work environment, in terms of their ability to work a set number of hours each week. Unlike many occupations, the work site is the client's home, and the home care worker must travel to and from that home. Care that is authorized is limited -- each visit is often two to four hours in length, and a case often lasts for only one or two months. (This is especially true for Medicare cases, where care is often acute and short-term; private pay patients may have care for longer periods of time.) Home care workers are usually not paid for their travel time (although they sometimes receive a small subsidy for travel costs), so workers must have at least two or three cases a day to piece together a full day's work. The work can involve late night and weekend shifts and there are usually no set schedules, making work hours extremely irregular; workers rarely receive extra compensation for accepting these irregular shifts. A sudden change in a client's health condition (e.g., recovery, hospitalization, or death) often results in a lack of work for a few days because of the time needed to schedule a new client (even though waiting lists for services usually exist). According to the experts we interviewed, instability in hours creates an "economic roller coaster" that has a pronounced effect on both recruitment and retention of workers; in fact, a New York survey of home health care workers indicated that guaranteeing weekly hours would have the largest effect on increasing job acceptability.[61]

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[60] Feldman (1990), p. 43.

b. Poor Wages and Fringe Benefits

Of the four occupations examined as part of this study, home health care is the only one for which the hourly wages and fringe benefits are extremely poor. The experts we interviewed note that home care workers perform a vital task in society, yet receive poverty wages for their work. Some researchers also feel that the low wages and lack of importance placed on the home care field is a form of discrimination against the women and minorities who dominate the field, noting that some segments of society feel this is "women's work" that does not merit substantial pay.[62] According to Rick Surpin, "Home care paraprofessionals are the last large group of health care workers to seek adequate wages and benefits and they are doing so at a time when financial resources are quite scarce...they work in a relatively new, highly fragmented system that has not yet been fully integrated into the health care mainstream."[63] This is partially due to the home care workers' lack of a national collective voice; unions and other lobbying coalitions have been able to increase wages on the state and local levels, but have not been able to produce nationwide changes thus far.

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[61] Long Term Care Policy Coordinating Council (1990), p. 36.

[62] Issues of labor markets segregated by gender and race are discussed in Feldman (1990), pp. 20-23, and in Surpin (1988), p. 29.

[63] Surpin (1988), p. 28. Rick Surpin is a member of the New York City Home Care Work Group, President of Cooperative Home Care Associates (a worker-owned home health care company in New York City), and Director of the Home Care Education Project of the Community Service Society in New York.

Wages and benefits have a significant impact on both recruitment and retention of workers. One survey indicates that introducing benefits -- specifically paid sick leave, paid vacation leave, and tuition reimbursement -- would have a much bigger impact on job acceptance than improving wages.[64] Medicare and payors for home care have placed payment caps on reimbursement based on agencies' historical costs, and certified agencies may not be fully reimbursed for wage increases given to their employees. By instructing fiscal intermediaries to tighten the interpretation of "medical necessity," Medicare put many agencies in a precarious position due to large increases in home care claim denials. Contract bidding procedures, which are often used by state and local governments to choose providers to deliver home care, reward agencies providing care at the lowest cost, and therefore greatly discourage increases in wages or benefits. While a limited number of firms do offer benefits such as sick leave, paid vacations, medical insurance, and tuition reimbursement, aides must work at least 30 to 35 hours per week to qualify, and few workers are consistently assigned an adequate number of hours. As a result, very few home care workers receive fringe benefits.

Our interviews and published articles indicate that taking an aide job in an institutional setting usually provides more financial stability than a home health care job. While aides in institutional settings (e.g., nursing homes) are required to have a level of education and training similar to home care paraprofessionals, institutional positions offer the stability of a full-time job, significantly higher wages (30 percent to 60 percent higher), overtime compensation, shift differentials for night work, and annual salary increases. The relatively low turnover within institutional positions makes them difficult to attain. Home care jobs offer more responsibility and autonomy than institutional jobs, which may be attractive to some people; however, the difference in compensation levels is a high premium to pay for the independence.

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[64] Long Term Care Policy Coordinating Council (1990), pp. 37-38.

There are a number of similar unskilled, nonsupervisory jobs which require the same level of paraprofessional workers as home care. Examples include hotel workers, laundry/cleaning workers, beauty shop assistants, and clerical workers. In 1985, the hourly average earnings for these occupations was about one dollar higher than for home care. Because jobs that are similar offer better wages, it is difficult for the home care field to attract and maintain a workforce.[65]

Another alternative for potential home care workers is public assistance. For many low-skill individuals, public assistance is more lucrative than employment in home care. Assuming (optimistically) that aides make $5 per hour, and are able to work 40 hours each week, their annual salary would be $10,400.[66] A welfare mother with two children and child care costs of $240 per month (the standard Aid to Families with Dependent Children allowance) would need to earn $12,000 as a home care worker to break even with the public assistance alternative.[67] This comparison, however, does not give consideration to non-wage fringe benefits, such as medical insurance, which are available under AFDC (i.e., Medicaid), but are rarely available to the home health worker.[68]

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[65] Kane (1989), pp. 29-30.

[66] Surveys indicate that the median annual salary is much lower. Feldman (1990), p. 25, estimates in the multi-state survey that median personal income was $7,000.

[67] Barnow (1988), p. 5-40.

c. Transportation and Travel

The transportation and travel required for home health care often deter many individuals from accepting a position. The potential home care worker is typically not able to afford a car and its upkeep, but the job requires travel back and forth to clients' homes. In urban areas where public transportation networks are extensive, this is less of a problem; however, in suburban and rural areas some potential workers cannot accept home care jobs because they are unable to get to clients' houses. In fact, one of the agencies we spoke with indicated that they did not have shortage problems, except for a few periodic instances when they were unable to hire workers with cars.

d. Low Job Status

The job status of home health care workers is frequently cited as a problem in recruiting workers. There is a general perception that home care is a "maid service," and it has a well-known reputation for being an entry-level, dead-end job. The relatively unskilled and untrained workforce exacerbates the poor image. Instead of being seen as helping, caring individuals providing an important service, home care workers have traditionally received little respect.

e. Limited Advancement Potential

Along with the poor job status of home care, the field is characterized by extremely limited advancement potential. Most home care jobs are dead-end; there is often little opportunity for raises or promotions. This lack of a career ladder creates retention problems. In general, firms feel that it is more expensive to retain workers by giving them raises or benefits than it is to recruit new workers. Therefore, workers usually do not receive financial rewards for their commitment to the occupation, the quality of care they provide, or their acquisition of new skills. The lack of opportunity significantly impairs many workers' desire to stay in home care jobs, despite the strong sense of self-worth and fulfillment most home care workers receive from their jobs.

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[68] The Family Support Act of 1988 does include transitional child care and medical benefits starting in April 1990; however, these were not available in the past.

f. Lack of Training

In the past, lack of training has been a hindrance to new and existing workers. If workers do not feel adequately prepared to take on the responsibility of caring for other individuals, they may leave the field.[69] While this may occur less with the implementation of the 1987 OBRA regulations, it still applies to workers who serve private pay clients exclusively or who are employed by non-certified home health agencies. Even though training is inextricably linked to the quality of care provided, many agencies do not offer their own training programs, and the worker almost always bears a portion of the financial responsibility for training -- the worker must either pay for the training course and/or accept no wages while attending training. It is extremely rare that an agency pays for training and also provides wages. The agencies' unwillingness to pay for training is another indication that home care workers are seen as replaceable and that agencies do not feel training these workers is a worthwhile investment. (Some agencies may not want to risk losing aides for whom they have invested in training.)

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[69] Donna Tuttle (Feb. 1989). "The Impact on Quality: Homemaker-Home Health Aide Training." CARING Magazine, p. 49; and Long Term Care Policy Coordinating Council (1990), p. 41.

g. Unclear Definitions and Responsibilities

There has been a recent move on the part of home care advocacy groups and experts in the field to establish clear definitions and responsibilities for home care workers. The current disparity of titles and responsibilities allows some programs to take advantage of workers by simply labeling them inappropriately. For example, calling a worker a homemaker instead of home health aide, but requiring the same responsibilities, may allow state programs to pay lower wages or not offer benefits (whereas the state would have to provide these items if they called the same person a home health aide). Many feel that the lack of job titles and corresponding responsibilities becomes a political game that diminishes the status of the home care field.

h. Size of the Current and Future Labor Pool of Workers

The size of the current and future relevant labor pool of workers is a key factor in the supply of home health workers. Bureau of Labor Statistics projections indicate that there is currently a large pool of individuals with characteristics similar to those who have traditionally been home care workers -- women, minorities, and the middle-aged (25 to 54 years old) -- and that their proportion in the labor force will continue to increase.[70] In addition, the opportunities for many low-skill jobs are declining and are projected to continue decreasing over the next 10 years.[71] This is due to (1) large growth in occupations with higher educational requirements, (2) stagnation of many jobs that are low or very low skilled, and (3) declines in some industries that employ large number of unskilled workers (primarily manufacturing businesses that have moved processes abroad or have been impaired by foreign competition). As a result, there is a large potential pool of workers available to enter the home care profession over the next 10 years. The actual number of home care workers, however, depends not just on the size of the potential pool of workers, but more importantly on the ability of the industry to recruit these potential workers into home care. Based on the issues already discussed (e.g., low wages, lack of fringe benefits, and job instability), the home care occupation may need to become more attractive before enough workers can be recruited to meet increases in demand.

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[70] See Burt Barnow, Amy Chasanov, and Abhay Pande (Apr. 1990). Financial Incentives for Employer-Provided Worker Training: A Review of Relevant Experience in the U.S. and Abroad. Washington, D.C.: Urban Institute Policy Memorandum, pp. 7-9.

[71] Barnow (1990), p. 4-7.

E. Adjustments to Shortages

This section discusses actions that are currently being taken by employers, advocacy groups, and the government to alleviate the current shortages in home care workers, and includes a discussion of the effects of these initiatives.

1. By Employers

Home care agencies are immediately affected when they must turn down business or wait-list clients because they are unable to provide home care services. The strategies discussed below have been taken by employers to alleviate personnel recruitment and retention problems.

a. Increase Wages and Benefits

Some employers, either due to regulations, funding from demonstrations, or through their own initiative, have increased wages or provided fringe benefits to home care workers. Employers who offer higher wages and/or benefits are better able to hire the workers they need. One employer we interviewed has a business that spans several county jurisdictions. In one of the jurisdictions wages and benefits were mandated by city wage orders at fairly high levels (over $7.00 per hour), while the other jurisdictions' wages were not mandated and were significantly lower. Where wages are higher due to mandates, there are no problems hiring workers, and in fact there are more qualified applicants than open positions. However, in the neighboring jurisdictions where the agency has fixed-price contracts with county social service departments, wages are lower and there is a chronic need to fill home care positions. As a result, the agency loses potential business to other home health care agencies with similar government contracts in some of its jurisdictions.

Three demonstration projects were funded by the Ford Foundation to restructure and upgrade the home care worker's job. The goal was to see if these changes could improve worker satisfaction, retention, and continuity of care.[72] One demonstration provided experienced workers with an hourly wage increment of $0.50 and enhanced fringe benefits; another demonstration increased hourly wages for workers serving specifically defined difficult cases (e.g., senile dementia, Alzheimer's disease). The results of these demonstrations indicated that increases in salaries and fringe benefits did improve worker retention. However, if the funding for this demonstration had not been provided, the agencies would not have had the autonomy to raise salaries and improve fringe benefits due to the role of third-party payors.

Some wage-related strategies are currently being used in certain areas across the country to improve recruitment and retention of workers. In New York, shift differentials are offered and state rate increases are tied to the provision of fringe benefits. These techniques have proven effective in alleviating labor shortages of home health care workers in the state.

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[72] Penny Hollander Feldman (February 1989). "The Ford Home Care Project: Reducing Turnover Among Paraprofessionals." CARING Magazine, p. 28-29; and Feldman, et al. (1990), Chapters 6-11.

b. Alleviate Transportation Problems

As mentioned above, most firms do not reimburse home care workers for their travel time, but some agencies provide a minimal subsidy for travel costs. The employers we interviewed use two major ways to successfully overcome the transportation barriers that often discourage a potential worker from accepting a home care position. One method is to reimburse for transportation to and from jobs at a more substantial rate. Another method is to have a company van transport aides either between their homes and public transportation, or between their homes and client homes. This strategy was adopted by one agency when hiring aides with cars became a major problem. Facilitating travel can be used to recruit more aides, and reimbursing travel expenses and/or time can help to make home care a more attractive job and stabilize the income of workers.

c. Improve Scheduling

Some agencies incorporate the concept of "shared aides" into their scheduling process. A shared aide serves clients who live in close proximity to one another; this pooling of clients helps stabilize a worker's hours and improves retention. Another method employed by some agencies is "mapper" technology. Many agencies are currently using inefficient, labor-intensive, and time-consuming methods where schedulers manually keep records of workers and clients to schedule client visits. Scheduling is often difficult because a home care worker may lack a telephone at home, may be on a case, or may be at a second job. In addition, special consideration needs to be given to both the client's needs (e.g., request for services in the morning) and the home care worker's needs (e.g., current caseload, transportation limitations). Increased use of management information systems and "mapper" technology allows agencies to computerize their scheduling process and utilize geographic information systems to plot transportation patterns that match clients and workers more efficiently. The use of both shared aides and mapper technology has helped New York to significantly change its severe labor shortage situation to a mild one.

d. Provide Training

Not all agencies provide training, primarily because it is costly and the high turnover characterizing the industry means that employers may not be able to recover their investments. Some furnish pre-employment training; the workers usually do not receive a salary and are hired for home care jobs at the end of the training/probation period. This is an important tool because many potential workers cannot afford to pay for a course at a local community college (or other location), but are willing to go unpaid for the period of training. Some agencies we spoke with believe that their training programs are an important tool in their recruitment of new workers.

One of the demonstration projects funded by the Ford Foundation offered extended training in basic home care skills, and another demonstration gave experienced workers specialized training in serving difficult cases. Other wage enhancements were offered in conjunction with the training, and the combination effectively reduced turnover. In addition to the acquisition of knowledge and skills, training helps home care workers get to know their co-workers and supervisors, and identify themselves with the employing agency. The study indicates that training can also help workers cope with isolation and loneliness, which are often factors in the decision to leave home care. There is currently a perverse system in the assignment of clients; new workers are often given "difficult" cases to "test" their commitment to the job, while experienced workers are assigned "easy" cases as their "reward" for their reliability. Offering specialized training to experienced workers in problem areas is one step closer to creating an advancement pattern for home care aides.

e. Increase Supervision

Some agencies increase the level of supervision and interaction with superiors in order to alleviate worker stress and alienation, and make the worker feel like part of a team. Employers who emphasize the role of supervision are more likely to ensure quality service and to increase their workers' job satisfaction through the reinforcement of training and the provision of an adequate support network.

f. Offer Recruitment Bonuses

One firm we interviewed offers small bonuses to current employees who bring in friends or relatives as new workers. This helps the firm attract new employees, and it emphasizes the importance of word-of-mouth recruiting practices.

2. By Advocacy Groups and Coalitions

According to the National Association for Home Care (NAHC) and others, defining the levels of care and a common occupational terminology will combat the fragmentation within the home care field, provide adjustments in compensation levels, and maintain adequate standards for certification and appropriate training. NAHC planned a conference aimed at standardizing the job titles, responsibilities, and levels of care within the home care field. Many of the experts we interviewed believe this is an important area in need of significant improvement, and are supportive of such a venture. The adoption of a nationally-recognized policy will need support by employers, state and federal governments, and others to be effective. Experts believe that this will eliminate many of the problems home care workers and agencies face due to the variety of funding sources, reimbursement policies, and amounts of covered care.

3. By Government

a. Offer Transitional Assistance to Former Welfare Recipients

To attract welfare recipients into the home care occupation, the job needs to be a better alternative than welfare. In the past, loss of medical insurance was one of the major reasons home care was not attractive to welfare recipients (many home care workers either are not offered medical insurance, or do not work enough hours to qualify for it). Under the Family Support Act of 1988, the government introduced transitional assistance for families after they lose AFDC eligibility because of increased earnings.[73] As of April 1990, states have extended Medicaid coverage for one year to families who no longer qualify for cash assistance because of increases in earnings. During the second six-month period, states can impose a premium for the Medicaid coverage on families whose income is above the federal poverty level. In addition to Medicaid coverage, transitional child care assistance is offered for 12 months; however, a sliding scale fee is imposed based on the family's ability to pay. While it is still too early to tell, this transitional assistance for welfare recipients may help recruit a new pool of workers into home care.

b. Increase State Reimbursement Levels

Some coalitions of agency administrators, workers, unions, elderly advocates, state agencies, and elected representatives have joined together in an effort to pressure state programs to increase wages and improve working conditions for home health aides. In particular, the Massachusetts and New York reimbursement systems have allowed for significant salary increases and benefits. Massachusetts regulates a uniform wage rate for all covered providers, and includes travel add-ons and differentials for weekend, evening, and holiday hours. Massachusetts also includes optional incentive add-ons to allow employers to encourage recruitment and retention. Under this type of add-on, agencies can offer additional incentives, such as health insurance, paid vacation and sick leave, guaranteed hours, or wage increments for tenure or performance, upon approval by the state's regulatory commission. It is important to note that the progress made in Massachusetts is the exception, and not the standard. This is a worthwhile area of exploration, especially in times of labor shortages, because it is through additional funding and changes in reimbursement policies that the wages of home care workers will ultimately increase.

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[73] Overview of Entitlement Programs, p. 612-13.

F. Conclusions and Recommendations

1. Conclusions

The home care occupation differs from the other three case studies because of the low wages, the low skill requirements, the dichotomy between private pay clients and clients from state and/or federally-supported programs in regard to training and reimbursement, and the unique demands of delivering care in a home setting. These characteristics create a labor market situation in which wages are inflexible for the majority of workers, employers are extremely hesitant to make any investments in human capital, and training and quality issues surround the non-Medicare segment of home care. The research presented in this chapter indicates that there is a shortage of home care workers in some areas of the country, and that it varies in intensity. The projected increases in new jobs and the high turnover rates within the occupation at this time suggest that innovative steps are necessary to combat current labor shortages and prevent future ones. This can be done by decreasing the barriers of entry into the occupation, increasing retention among home care workers, and increasing the productivity of existing workers.

2. Recommendations

a. Increase Training

The new Medicare quality assurance legislation requires either (1) training and competency certification, or (2) competency certification. Many of the experts we spoke with are supportive of the new legislation; they believe it will foster higher quality care, legitimacy for the field, and standards for training. Our research indicates that increased training is directly related to job satisfaction -- better trained workers are more comfortable with the daily responsibilities of their jobs. Experts in the home care field support training requirements for all federal programs, including home care provided under all sections of the Social Security Act. They feel that private pay patients should also be guaranteed quality care, and that mandatory training for all home care workers is a necessary step in assuring high quality care.

Feldman et al. suggest that training monies are well spent if they reinforce and supplement basic training and develop special skills or a career track within the home care field. The Ford Foundation demonstration projects indicate that training results in decreased turnover and improvements in continuity of care. General training is a valuable tool in building a support network of co-workers and supervisors, and specialized training leads to the development of advancement opportunities for experienced home care workers.

While increasing training may on the surface appear to hinder the ability of some individuals to become home care workers, there are methods that could be adopted to provide low-cost or free training to workers. Through the implementation of employer-reimbursed training policies, federal programs such as the Job Training Partnership Act (JTPA), and other state and federally-sponsored training demonstrations, potential workers can be trained.[74] Firms that are hesitant to invest in training could require workers to sign limited employment contracts (e.g., one year) so that employers could be reasonably assured they would reap some of the benefits of their investment.

b. Establish a Career Ladder

To make the job more attractive to current and future home care workers, employers should consider developing advancement opportunities for their workers. Raises and promotions are more difficult under programs with tight reimbursement limits; however, some strategies can be taken. Some researchers suggest that there should be two promotional tracks established in the home care field -- administrative and clinical.[75] Home care workers could be offered a clinical track, where they would be given the opportunity to specialize in certain types of care (e.g., Alzheimer's disease, AIDS) that would involve the acquisition of advanced skills through additional training and would be a promotion from more general care. Progression to administrative positions, such as senior home aides, field supervisors, and caseload managers, could be established as an alternate career track. These two advancement opportunities could improve recruitment and retention, the quality of care provided, and the image of home care work.

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[74] It is important to note that home care workers' wages are currently so low that JTPA programs are unwilling to train workers for the occupation. Such training would effect their ability to meet performance standards.

[75] Feldman (1990), pp. 202-3.

c. Standardize Titles and Definitions

As discussed earlier, some groups are devising proposals for consistent national job titles, responsibilities, and levels of care within the home care field. While some states already have standard titles and definitions, a national approach is necessary to ensure that all government-funded programs adopt the same standardized system. This is an opportunity to increase the status of the home care occupation, provide needed adjustments in compensation levels, and maintain adequate standards for certification and appropriate training. A successful standardization of state and national titles and job descriptions needs support by employers, state and federal governments, and other involved interest groups. NAHC and others believe that this will eliminate many of the controversies that currently exist due to the variety of funding sources, reimbursement policies, and amounts of covered care.

d. Increase Wages and Benefits

As discussed earlier, mandated wage levels and current reimbursement policies have an overwhelming effect on the wages and benefits workers receive. Studies cited earlier have shown that increases in wages and benefits, primarily in the form of vacation and sick leave, paid tuition, and medical insurance, have a major impact on job acceptability. Serious consideration by employers and the government should be given to increasing wages and benefits for home care workers. Federal and state governments regulate wages for a significant portion of the home care market, and they should consider more frequent and accurate wage updates, especially during periods of rapid wage increases or particularly tight labor markets. It should be noted that one of the experts we spoke with warned that agencies view increasing wages as the easiest way to recruit new workers, and that requesting additional reimbursement should not be the only method used to improve recruitment and retention. However, the issues of poverty wages and lack of fringe benefits that plague most of the home care industry exist primarily because of the low reimbursement levels of third-party payors.

Some researchers state that the home care industry should strive toward parity with institutional wages -- that home-based and institutional aides perform the same basic tasks and societal preference supports home care over institutionalization. Making the wages and benefits of home care aides competitive with those in hospitals and nursing homes requires changes in third-party reimbursement. Other wage-related methods of recruiting and retaining workers include wage differentials and expanded benefits to reward employees for length of service, reliability, and acquisition of new skills. This provides positive reinforcement and could be linked to advancement opportunities to make the job more attractive. Case closings have been identified as times associated with higher levels of turnover, so transitional pay could be used for valued aides who are between cases. Like aides in institutions, home care workers could also be given shift differentials to compensate them for weekend and late night work.

e. Stabilize Hours

Full-time, year-round employment for those workers willing to make this commitment could be a goal for employers; this would provide a comprehensive solution to many of the unstable aspects of the job (e.g., hours, wages, and benefits). There are some workers who desire part-time work (20 to 30 percent), and of the remaining workers, many may not be able to work full-time. A guaranteed hours policy is more easily attained when clients get four or more hours of service, but it is much harder when the average length of visits is shorter.

There are a number of intermediate methods that could also be adopted to stabilize the hours and pay that home care workers receive. One method is through the use of shared aides -- one aide serves two or more clients in the same area and can therefore work more hours. Another way is to set a minimum visit time (e.g., four hours), so that an aide is given a minimum number of hours for each client visit, even if the visit is relatively short. A guaranteed number of hours each week could be given so that when events occur outside of the home care worker's control (e.g., a client cancels a visit, a previous client no longer needs services, and a new client has not been scheduled), the worker would still get credit for the hours. Paying workers for their time spent traveling to and from clients' homes would increase workers' hours and would offset lost earnings for time spent in transit between clients.

CHAPTER 5

CASE STUDY OF ELECTRICAL AND ELECTRONIC ENGINEERS

A. Description of the Occupation

Electrical and electronic engineers design, develop, test, and supervise the manufacture of electrical and electronic equipment. According to the Department of Labor's Dictionary of Occupational Titles:

> ...This group includes occupations concerned with the application of the laws of electrical energy and the principles of engineering for the generation, transmission, and use of electricity...Electrical engineers conduct research and development activities concerned with design, manufacture, and testing of electrical components, equipment, and systems; applications of equipment to new uses; and manufacture, construction, and installation of electrical equipment, facilities, and systems... Electronic engineers conduct research and development activities concerned with design, manufacture, and testing of electronic components, products, and systems, and in development of applications of products to commercial, industrial, medical, military, and scientific uses.[1]

Some areas of specialization within the field include electrical power transmission and generation; atomic power generation; electrical and electronic components; equipment and systems manufacturing; radio and television broadcasting; and telephone, telegraph, and electronic computer engineering. There are also many highly specialized and emerging sub-specialties within the field -- e.g., industrial robotics control systems, stealth (defense) technology, and artificial intelligence. As demonstrated in Exhibit 5.1, electrical and electronic engineering is the largest branch of engineering -- employing 581,000 workers or 31.2 percent of all engineers in 1990. An overview of other leading branches of

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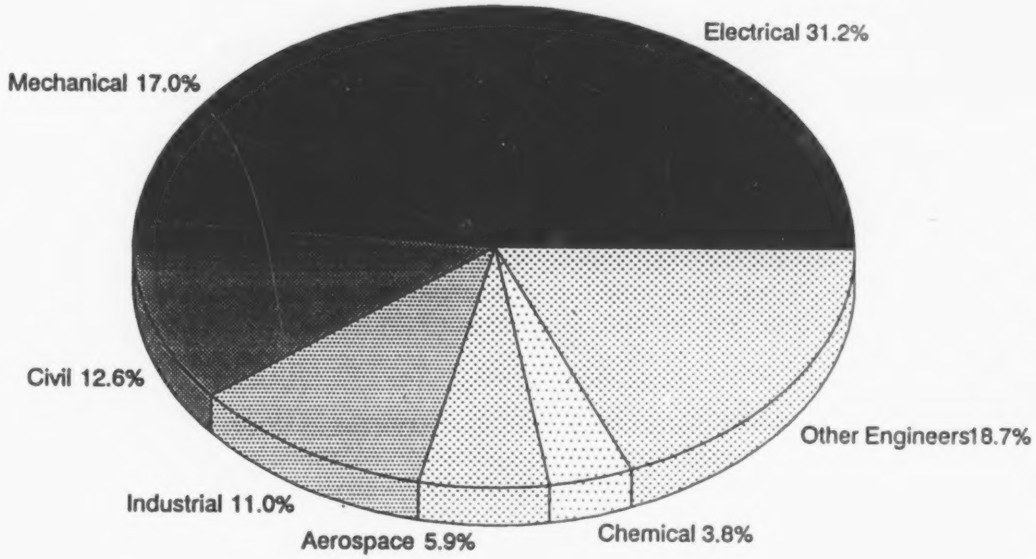
[1] U.S. Department of Labor, Employment and Training Administration (1977). Dictionary of Occupational Titles. Fourth Edition, p. 17.

Exhibit 5.1: Employment of Engineers, by Engineering Branch, 1990

Specialty	Number of Engineers	Percent of Total
Electrical	581,000	31.2%
Mechanical	316,000	17.0%
Civil	234,000	12.6%
Industrial	204,000	11.0%
Aerospace	109,000	5.9%
Chemical	71,000	3.8%
Other	348,000	18.7%
Total	1,863,000	100.0%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

engineering is shown in Exhibit 5.2.[2]

The electrical and electronic engineering field is of considerable interest to labor market analysts for several reasons. Engineering is a field that has had alternating periods of (at least perceived) shortages and surpluses for a number of years. Shortages within the engineering field have been the subject of many studies since World War II. For example, in 1958 Arrow and Capron used the engineer-scientist market as the focus of their seminal work on labor shortages. They offered several possible explanations for what they termed "dynamic shortages":

> ...A dynamic shortage is a possible explanation of the observed tensions in the engineer-scientist market because (1) there has been a rapid and steady rise in demand, (2) the elasticity of supply is low, especially for short periods, and (3) the reaction speed on the engineer-scientist market may, for several reasons, be expected to be slow.[3]

Over the years, there have also been periodic complaints by employers about an inadequate supply of engineers.[4] Although the unemployment rate among engineers is typically quite low, there have also been times when there was an apparent surplus of engineers:

> ...When the nation cooled its miliary-industrial jets in the early 1970s, widespread unemployment among engineers resulted. Hordes of designers laid off from the lull

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[2] Estimates of the number employed within the field are based on the Current Population Survey. For more detail on each of the branches of engineering, see: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Outlook Handbook 1990-91, pp. 63-70.

[3] Kenneth J. Arrow and William M. Capron (May 1959). "Dynamic Shortages and Price Rises: The Engineer-Scientist Case." Quarterly Journal of Economics.

[4] For example, C.B. Jolliffe (June 21, 1956), in "Electronics: A Case Study of the Shortage of Scientists and Engineers," delivered to the President's Committee for the Development of Scientists and Engineers, in discussing his own company argued: "We could use one thousand more right now without any question. Where could we use them? Mainly on military contracts because it is here -- rather than in consumer and industrial electronics --that the pinch is tightest."

Exhibit 5.2: Overview of Other Leading Branches of Engineering

- **Aerospace Engineers** design, develop, test, and help produce commercial and military aircraft, missiles, and spacecraft.
- **Chemical Engineers** work in many phases of production of chemicals and chemical products. They design equipment and plants, determine and test methods of manufacturing the products, and supervise production.
- **Civil Engineers** design and supervise the construction of roads, airports, tunnels, bridges, water supply and sewage systems, and buildings.
- **Industrial Engineers** determine the most effective ways for organizations to use the basic factors of production (e.g., labor, equipment, materials, information, and energy). They design a variety of systems to support the operations of firms, including data processing systems, management control systems, and planning and control systems to coordinate activities and control product quality.
- **Mechanical Engineers** are concerned with the production, transmission, and use of mechanical power and heat. They design and develop power-producing machines such as internal combustion engines, steam and gas turbines, and jet and rocket engines. They also design and develop power-using machines, such as refrigeration and air conditioning equipment, robots, and machine tools.
- **Other Engineers** include mining engineers; agricultural engineers; nuclear engineers; metallurgical, ceramic, and materials engineers; petroleum engineers; and marine and naval architects.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Outlook Handbook 1990-91, pp. 62-70.

> in NASA projects joined those let go from Vietnam wartime industries. Newspapers even ran stories of engineers driving taxi cabs.[5]

Interestingly, the literature on engineering shortages is not conclusive or consistent: different analysts have used alternative definitions of a shortage and different evidence to assess whether a shortage exists.[6] At the time this study was done, some analysts were forecasting serious shortages of engineers, which they predicted would emerge in the mid-1990s and continue well into the next century:

> ...The demographics of the college-age population combined with estimates of the percentage of students who will pursue careers in science and engineering indicate significant shortfalls between supply and demand for the next several decades at both the baccalaureate and Ph.D. levels. If these projects are realized, the shortage of technical personnel will have a major impact on economic growth, international competitiveness, and national security.[7]

A 1989 report by the National Science Foundation[8] warned of the potential for future scarcities of natural scientists and engineers because of decreases in the overall number of bachelor degree graduates, declining interest in natural science and engineering among college students, and an increasing retirement rate among existing scientists and engineers in the 1990s. Other researchers and organizations have argued that no such shortages are likely and that the natural forces of labor supply and demand will result in adequate numbers of engineers into the next century. In short, there is substantial disagreement about the likelihood of future shortages and the factors that might lead to such shortages.

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[5] D. L. Gardner (February 26, 1990). "What Defense Cuts Mean to Engineers." Design News.

[6] For example, Arrow and Capron criticize Blank and Stigler for defining a shortage as follows: "A shortage exists when the number of workers available (the supply) increases less rapidly than the number demanded at the salaries paid in the recent past." Arrow and Capron argue that Blank and Stigler's definition relates to the symptoms of a shortage rather than the existence of a shortage. See David J. Blank and George J. Stigler (1957). The Demand and Supply of Scientific Personnel. New York: National Bureau of Economic Research.

[7] R. Atkinson (April 27, 1990). "Supply and Demand for Scientists and Engineers: A National Crisis in the Making." Science, p. 425.

[8] National Science Foundation, Division of Policy Research and Analysis (November 13, 1989). Future Scarcities of Scientists and Engineers: Problems and Solutions, Working Draft.

Electronic and electrical engineers comprise the largest and perhaps most dynamic of the engineering fields. It is an occupation that is integral to the national defense (and substantially affected by defense expenditures), as well as essential for high technology advancement in the service and manufacturing sectors. Rapid technological change has meant that this group of engineers has had to continually upgrade their skills or become obsolete.

Finally, the Bureau of Labor Statistics, the National Science Foundation, and many other organizations forecast rapid growth in employment for electrical and electronic engineers and the rapid emergence of new specialties in the field. For example, the BLS predicts that employment of electrical and electronic engineers will grow by 48 percent between 1986 and 2000 (under a moderate growth assumption), well above the average for all occupations. At a time when many electrical and electronic engineers are expected to reach retirement age and a sharp decline in the number of new entrants to the workforce is anticipated, this strong demand has heightened concern among employers and labor market analysts about the potential for future shortages.

B. Training and Recruitment of Electrical and Electronic Engineers

1. Educational Qualifications and Entry Requirements

General qualifications and entry requirements for electrical and electronic engineers are described in detail in the Department of Labor's Occupational Outlook Handbook:

> A bachelor's degree in engineering from an accredited engineering program is generally acceptable for beginning engineering jobs. College graduates with a

> degree in science or mathematics may occasionally qualify for some engineering jobs, especially in engineering specialties in high demand. Most engineering degrees are granted in branches such as electrical, mechanical, or civil engineering. However, engineers trained in one branch may work in another.[9]

There are also two- and four-year college programs in engineering technology, which prepare students for practical design and production work, rather than for jobs that require more theoretical scientific and mathematical knowledge. Graduate training is essential for engineering faculty positions, but is not required for the majority of entry-level engineering jobs. Many engineers earn master's degrees to learn about new technologies or specialties, to broaden their education, and to enhance promotion opportunities.[10]

Admission requirements for undergraduate engineering schools include coursework in advanced high school mathematics and the physical sciences. In a typical four-year college curriculum, the first two years are spent studying basic sciences -- e.g., mathematics, physics, chemistry, introductory engineering, and the humanities, social sciences, and English. In the last two years, most coursework is in engineering, usually with a concentration in one branch. Some colleges and universities offer five-year master's degree programs.

Many universities also offer five- and even six-year cooperative engineering programs, which formally combine classroom study and practical work experience permitting students to finance part of their educations. For example, at the George Washington University's School of Engineering and Applied Science, student involvement in the cooperative program is generally arranged after the student has successfully completed the first year of study. Employers participating in the program typically require students to work during the summer immediately following their freshman year. The students will then return to the university for their sophomore year, working again during the second summer. During the third and fourth years, students alternate between work and classroom instruction each semester, returning to the classroom for the fifth and final year. Alternately, they may work for a full academic year and then return to the university the following year. The emphasis and schedule of cooperative programs vary somewhat from university to university. For example, the cooperative program at the Massachusetts Institute of Technology (MIT), which involves research-minded firms such as Texas Instruments, IBM, General Electric, Bell Labs, Comsat, and others, stresses the importance of engineering students being involved in actual research with their employers. Cooperative programs not only provide an important link between study and work, but also present an opportunity for employers to evaluate students as prospective permanent employees and for students to view employers in terms of their interests and future plans.

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[9] Occupational Outlook Handbook, p. 63.

[10] Occupational Outlook Handbook, p. 63.

After graduation, new entrants to the electrical and electronic engineering field usually do routine work under the close supervision of experienced engineers, and may also receive formal classroom or seminar-type training. For example, according to an official we interviewed at a major computer manufacturing firm, new electrical engineers will "generally work closely with a more experienced engineer, who will show them the ropes." As they gain knowledge and experience, they are assigned more difficult tasks with greater independence to develop designs, solve problems, and make decisions.

All states (and the District of Columbia) require registration for engineers whose work may affect life, health, or property, or who offer their services to the public. Registration generally requires a degree from an engineering program approved by the

Accreditation Board for Engineering and Technology (ABET), four years of relevant work experience, and passing a state competency examination.[11]

2. Methods Employers Use to Recruit Electrical and Electronic Engineers

Employers use a variety of methods to recruit electrical and electronic engineers. These methods will differ depending upon whether the firm is seeking to recruit new entrants to the field from engineering schools or experienced engineers who are already employed within the workforce.

The most pervasive method for recruiting students enrolled in engineering programs -- at the baccalaureate, master's, and Ph.D. degree levels -- is through university or college job placement offices. University job placement programs have established close relationships with many employers who recruit electrical and electronic engineers. For example, the job placement office at one leading engineering university schedules interviews for 700 companies that come to the campus annually. According to the director of the job placement office at a second major engineering university, much of the burden and costs of the job search for the graduating students is eliminated:

> ...It is really almost too easy for students. As is the case at almost all engineering schools, flocks of firms come to the school for the purpose of recruiting engineers. Resumes of students are even kept in a data base at the school. Recruiters come on campus and interview students. If the interview is successful, a second interview usually follows and then the student will be flown out to the employer for a round of interviews. If this goes well, the employer then will extend an employment offer.

Universities also hold job fairs, where employers set up booths to provide prospective recruits with information about employment opportunities and to schedule interviews.

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[11] Occupational Outlook Handbook, p. 63.

For their part, employers make substantial investments to ensure an adequate flow of engineering manpower to meet their specific requirements. Large- and medium-size employers typically maintain a recruiting force that has strong linkages with the engineering colleges and universities and regularly visit the campuses to conduct interviews and attend job fairs. Employers will typically target certain engineering schools that have, in the past, provided a steady stream of qualified recruits. For example, one large defense contracting firm interviewed for this report has "team captains" (or college recruiters) who work closely with job placement offices and faculty at 25 "key" universities (from which the firm has had the best success in past recruiting) to identify potential engineering and science graduates. Through university job placement programs, employers are able to generate a large pool of qualified candidates and to rapidly screen this group to a core of engineers who are likely to meet their specific workforce requirements.

Cooperative programs are also an important method that employers use to recruit electrical and electronic engineers from universities. As discussed earlier, these programs enable students to alternate periods of college study with periods of work experience. The work experience provides employers with opportunities to evaluate the students as prospective employees. For example, the Cooperative Education Program in Engineering at the George Washington University estimates that about half of the cooperative education graduates remain in permanent positions with their employers after graduation.[12]

The methods used by employers to recruit experienced engineers differ from those used to attract new entrants. Some employers run advertisements in newspapers and trade journals, which are aimed at recruiting experienced engineers (most often with two to five years of experience) or engineers with expertise in certain sub-specialties of electrical and electronic engineering. Other companies use employment agencies, though this method entails the payment of a fee by the employer to the recruitment agency. Word-of-mouth and professional trade organizations can also be important sources of prospective employees. Finally, employers also receive job applications and resumes directly from potential recruits. For example, a recruiter from a major aerospace company indicated that the firm receives in excess of a half million job applications and resumes per year.

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[12] The George Washington University (1989). The George Washington University Bulletin: School of Engineering and Applied Science: 1989-1990. Washington, D.C., p. 41.

3. Methods Workers Use to Seek and Obtain Employment

The methods that electrical and electronic engineers use to seek and obtain employment are, for the most part, the reverse of those used by employers. Again, the methods vary according to whether the individual is still attending a university (either as part of an undergraduate or graduate program) or is already in the workforce. Those who are currently attending college typically use the services available through the university's job placement office. These services assist students with developing resumes, analyzing career interests, identifying potential employers, and scheduling interviews and visits with companies. As discussed earlier, students also attend job fairs/workshops, respond to advertisements in trade journals and newspapers, and rely on word-of-mouth. A good opportunity for students to observe employers comes through the cooperative programs run by most engineering schools.

Experienced electrical and electronic engineers are most likely to use the following methods: (a) send resumes to employers, (b) respond to advertisements in trade journals or newspapers, (c) use search firms, or (d) rely on word-of-mouth referrals.

4. Characteristics of Workers in the Occupation

Much has been written in recent years regarding the demographic characteristics of engineers and the ways in which these characteristics may affect future labor market conditions. Several of the most important trends are discussed below.

a. Age Distribution

Two aspects of the age distribution of electrical and electronic engineers have led some analysts to forecast possible shortages:

- an increase in the average age of the existing workforce, which is expected to boost replacement demand; and
- a decline in the number of B.S. and Ph.D. graduates with engineering degrees, which is expected to reduce the supply of new entrants into the engineering fields.

The average age of electrical and electronic engineers has risen sharply in recent years. Between 1976 and 1986, the proportion of electrical and electronic engineers over 50 years of age increased from about 17 percent to 31 percent. Further, in 1976 about 27 percent of employed electrical and electronic engineers were under 30 years old compared to 18 percent in 1986.[13] Replacement demand for electrical and electronic engineers is expected to nearly double during the latter part of the 1990s, as increasing numbers of the existing engineering workforce reach retirement age. For example, it is estimated that one-third of the current faculty at engineering schools will have to be replaced during the 1990s.

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[13] National Science Foundation (1988). Profiles -- Electrical/Electronics Engineering: Human Resources and Funding. Washington, D.C.: NSF-88-326, p. 15.

At the same time, the supply of new entrants into engineering programs at the bachelor's, master's, and Ph.D. degree levels is expected to decrease because of the demographics of the U.S. population:

> ...The crisis that is being widely predicted over the next decade is rooted in an incontrovertible demographic fact: because of low birthrates in the 1960s and 1970s, the college age population -- the raw material for tomorrow's educated workforce -- is shrinking. According to the Census Bureau, numbers of 18- to 24-year-olds will bottom out at a little under 24 million in the mid-1990s -- compared with a peak of over 30 million in 1980. Currently, a little over 5 percent of 22-year-old Americans earn B.S. degrees. Unless that fraction is increased, say the National Science Foundation (NSF), there will be a shortage of 400,000 scientists and 275,000 engineers in 2006.[14]

In order to make up for this shortfall in college students, the proportion of students receiving engineering degrees will have to increase substantially. Yet, according to Atkinson, the National Science Foundation, and others this increase is unlikely:

> ...Can such an increase be accomplished? The historical data are not encouraging. Between 1960 and 1980, the fraction of 22-year-olds receiving baccalaureate degrees in the natural sciences and engineering (including computer science) combined hovered at about 4 percent. In the 1980s, the rate began to rise and reached 5.3 percent in 1986. Recent data indicate that the conferral rate in 1990 will be 4.5 percent, at best. That rate would have to increase to more than 6 percent by the turn of the century to maintain the current supply of scientists and engineers.[15]

Hence, many labor market analysts -- though not all -- are concerned with the supply pipeline of new entrants to the field of electrical and electronic engineering.

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[14] C. Holden (June 30, 1989). "Wanted: 675,000 Future Scientists and Engineers." Science. Vol. 244, p. 1536.

[15] Atkinson (1990), p. 427.

b. Women

While over the past 20 years there has been a substantial increase in the number of women entering engineering fields, the rate of growth has slowed recently and perhaps even reversed. Women now earn about 45 percent of bachelor's degrees and 30 percent of Ph.D.'s in science and engineering. While women earned only about 3 percent of all engineering degrees in 1976, they were awarded almost 15 percent of the degrees in 1985. According to statistics compiled by the Engineering Manpower Commission, the number of employed women engineers grew at a rate almost five times greater than that of the profession as a whole between 1976 and 1986, and more women have entered the engineering labor force over the past few years than ever before.[16]

Trends within the electrical and electronic engineering field have followed similar trends as those for engineering overall. According to the National Science Foundation, despite recent gains women still account for a relatively small proportion of the occupation: in 1986, women comprised 3.3 percent of all electrical and electronic engineers. Among major engineering branches, only mechanical engineering (2.4 percent) had a lower proportion of women. Across all engineering fields, women accounted for 4.1 percent of engineers. Despite the relatively small proportion of women within the occupation, until recently the annual rate of growth for women in electrical and electronic engineering was four times that of men: between 1976 and 1986, the annual growth rate for women in this field was 28 percent compared to 7 percent for men.[17]

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[16] S. Kandebo (December 5, 1988). "Declining Female Enrollments Threaten Gains of Early 1980s." Aviation Week and Space Technology, p. 41.

[17] Profiles -- Electrical/Electronics Engineering: Human Resources and Funding, p. 17.

Despite long-term gains, there is concern that the entry of women into engineering careers has stalled in recent years. According to the Engineering Manpower Commission, the number of females enrolled in engineering schools climbed rapidly from 1973 to 1982, but peaked in 1983 when women accounted for 17 percent of all freshmen engineering students. Thereafter, female freshmen engineering enrollments declined, to about 15 percent. The retention rate for women in engineering from their freshman year to bachelor's degree also has dropped.[18] There also appears to have been a slight decrease in female interest in engineering. For example, an annual survey of freshmen found that in 1982 about 4 percent of all women freshmen were interested in engineering, while in 1986 that figure had dropped to 3 percent.[19] Holden attributes the slowdown in the number of women entering the sciences and engineering to lingering disparities between males and females:

> ...The slowdown is not surprising: Women scientists still suffer higher unemployment, lower pay, and fewer opportunities for promotion at every degree level than do males. According to the Office of Technology Assessment (OTA), "the gender gap in recruitment to and participation in science, reduced by two decades of gains, is in danger of widening now."[20]

The slackening pace at which women are entering the engineering professions has caused some concern about the future supply pipeline for engineers. Net new entrants to the workforce into the next century are expected to be mainly women, immigrants, blacks, and Hispanics -- groups that have been traditionally underrepresented in engineering fields. For example, according to Workforce 2000, the female share of the labor force will continue to grow:

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[18] Kandebo (1989), p. 39.

[19] Kandebo (1989), p. 41.

[20] Holden (1989), p. 1537.

> ...By the year 2000, approximately 47 percent of the workforce will be women, and 61 percent of women will be at work. Women will comprise about three fifths of the new entrants into the labor force between 1985 and 2000.[21]

In order to replace retiring engineers and meet the expected strong demand for electrical and electronic engineers, many analysts feel that continued growth in the entry of women into the field will be an important factor in determining whether there is an adequate supply of future engineers.

c. Blacks and Other Minorities

The number of blacks and Hispanics entering engineering fields is very low, with little to suggest a change in the future. While blacks and Hispanics make up more than 20 percent of the U.S. population, they receive only about 7 percent of B.S. degrees and 4 percent of all science and engineering doctorates. Approximately 1 percent of individuals with doctorates in the physical sciences, engineering, math, and computer sciences are black and Hispanics.[22] In certain fields within the physical sciences, it is next to impossible to find a black candidate to interview for an open position. For example, in 1988 only one black U.S. citizen earned a Ph.D. in mathematics and only one in computer science.[23]

Within engineering in 1987, blacks earned about 3 percent of the bachelor's degrees, 1.5 percent of the master's degrees, and 0.4 percent of the Ph.D.'s. Hispanics earned 2.3 percent of engineering bachelor's degrees, 1.6 percent of master's degrees, and 0.6 percent of Ph.D.'s. The lack of success in recruiting minorities to engineering, in general, is also reflected in employment trends within the electrical and electronic engineering field. In 1986, a relatively small proportion of electrical and electronic engineers were black (2.1 percent), Native American (0.6 percent), and Hispanic (2.1 percent). The proportion of blacks within the electrical and electronic engineering branch was marginally above the average for all engineering professions (1.7 percent). Between 1976 and 1986, the average annual rate of employment growth for blacks (15 percent) was about double the rate for whites (7 percent).[24]

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[21] W. Johnston and A. Packard (June 1987). Workforce 2000: Work and Workers for the Twenty-First Century. The Hudson Institute, p. 85.

[22] Office of Technology Assessment (1988). Educating Scientists and Engineers: Grade School to Grad School.

[23] R. Pool (April 27, 1990). "Who Will Do Science in the 1990s?" Science. Vol. 248, p. 435.

Despite some recent growth, most analysts expect that the number of blacks, Hispanics, and other minorities (except Asian-Americans) entering engineering will continue to be very low:

> ...There are at least some bright spots in the picture of women in the sciences, but this is not true of underrepresented minorities -- blacks, Hispanics and American Indians. These groups have failed to come into the system in sizable numbers, and nothing seems likely to happen in the 1990s to increase the flow of underrepresented minorities into science much past the trickle that is now.[25]

The historic problems that the electrical and electronic engineering field (and engineering, in general) has had in attracting minorities is of future concern, in part, because minorities (and women) are expected to be a major source of the net new workers who will be available to replace retiring workers within the field. For example, according to Workforce 2000:

> ...Over the next 13 years, blacks, Hispanics and other minorities will make up a large share of the expansion of the labor force. Non-whites, for example, will

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[24] Profiles -- Electrical/Electronics Engineering: Human Resources and Funding, p. 18-19.

[25] Pool (1990), p. 435.

comprise 29 percent of the net additions to the workforce between 1985 and 2000 and will be more than 15 percent of the workforce in the year 2000.[26]

Unfortunately, most researchers feel that given the continued high drop-out rates from high school and college by blacks, Hispanics, and American Indians -- and the extreme reluctance of these groups to enter (and complete) engineering programs -- little change can be expected in the future.

Among minorities, there is one bright spot -- the increasing number of Asian-Americans entering engineering fields. For example, if both U.S. citizens and foreigners with permanent visas are included, Asian-Americans account for 16 percent of all Ph.D.'s in engineering.[27] At one leading engineering university, 27 percent of the freshman class in the 1990-91 academic year was Asian-American. According to the National Science Foundation, in 1987, 6.6 percent of all electrical and electronic engineers were Asian-Americans, compared to 5.4 percent for all engineering fields.[28]

C. Employment and Earnings in Electrical and Electronic Engineering

In this section, aggregate data on employment and earnings is presented for electrical and electronic engineers in relation to general trends within the United States and compared to other engineering occupations.

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[26] Johnston and Packard (1987), p. 89.

[27] Pool (1990), p. 435.

[28] Profiles -- Electrical/Electronics Engineering: Human Resources and Funding, p. 19.

1. Employment Trends

The number of persons employed as engineers, and within the various branches of engineering, depends upon the source of the data. As shown in Exhibit 5.3, three major sources provide data on the number of engineers employed within various engineering branches (two of these data sources are collected by the Department of Labor's Bureau of Labor Statistics). According to which source is used, the number of engineers employed within the electrical and electronic engineering field varies. For example, in 1986 estimates of the number of electrical and electronic engineers ran as high as 620,700 (by the National Science Foundation) and as low as 391,529 (according to the BLS' Occupational Employment Survey).[29] Recognizing these differences, we have used Current Population Survey (CPS) data because it (a) uses the same definition as the decennial census, (b) is available on an annual basis broken down by distinct engineering branch, (c) is comparable with unemployment and earnings data, and (d) is based on an individual's (rather than an employer's) identification of their work.

Changes in the level of employment within an occupation generally reflect trends in demand for workers within the occupation. An increase in employment suggests an increase in demand, while a decrease suggests a decline in demand. A labor shortage is generally more likely to occur if demand is increasing than if it remains constant or declines because the supply of workers may not be sufficient to meet the growing demand.

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[29] See J.D. Alden (January 1989). "How Many Engineers?" American Association for Engineering Societies, Inc., Number 92, for a detailed discussion of the various data bases used to estimate the number of engineers and a methodology for partially reconciling differences in estimates of employment across various data bases.

Exhibit 5.3: Major Sources of Employment Data on Engineers

- **Current Population Survey (CPS)**, collected by BLS, is a survey of households. Based on interviews at about 60,000 locations, this survey is intended to provide broad statistics on employment, by demographic and educational characteristics. The survey, which uses the same occupational categories as those used in the decennial census, provides annual estimates of the number of engineers by major engineering branch. One problem with the CPS is that the survey depends upon the person who happens to be interviewed to accurately describe the occupational status of the household members. As pointed out by the American Association of Engineering Societies (AAES), "household data probably inflate the numbers of engineers reported, if only because some paraprofessionals who are technicians may prefer to use the more prestigious term 'engineer' to describe their jobs.

- **The Occupational Employment Survey (OES)**, BLS's payroll survey, is based on questionnaires mailed to about 240,000 employers. Under this survey, workers are categorized by their employers according to their current assignments, not by their education and training. As indicated by the AAES, this tends to yield conservative estimates because individuals who might be regarded as engineers by the profession are classified under other headings, such as college faculty, administrators and managers, and sales personnel. In addition, the OES estimates are lower than the CPS estimates because the employer survey does not cover the self-employed who are covered in the household survey.

- **National Science Foundation's Scientific and Technical Personnel Data System (STPDS)** is a large computer-based model that depends on input from three surveys: the Survey of Science, Social Science, and Engineering Graduates; the Survey of Doctorate Recipients; and the National Survey of Natural and Social Scientists and Engineers. Data from these three surveys, which are conducted biennially, are weighted and combined in a complex computer program to produce estimates of the total U.S. population of scientists and engineers (by branch). The NSF estimates tend to be higher because an individual does not have to be an engineer to be classed as an engineer. NSF's definition also includes individuals with only two-year associate degrees.

Source: John D. Alden (January 1989). "How Many Engineers? American Association of Engineering Societies. Number 92.

Exhibit 5.4 shows that employment levels for electrical and electronic engineers increased by about 131,000 workers between 1983 and 1990 (from 450,000 to 581,000). In absolute terms, the electrical and electronic engineering field grew by a much larger margin than any other engineering branch (e.g., all other branches of engineering together grew by 160,000 workers over the same period).

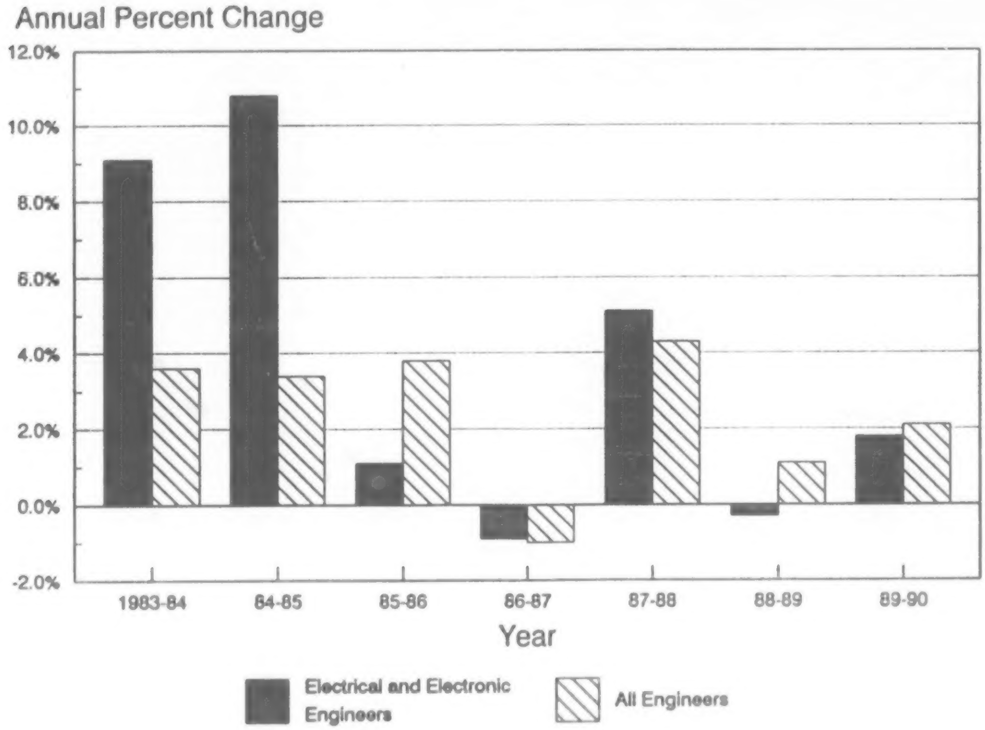
Between 1983 and 1990, the annual rate of growth for electrical and electronic engineers (3.8 percent) was nearly double that of the U.S. average for all occupations (2.1 percent), and double that for other engineering fields (1.9 percent). Annual growth in the number employed within the electrical and electronic engineering branch was also above that of other engineering fields, with the exception of aerospace engineers:

Engineering Branch	Annual Growth (1983-1990)
Aerospace	4.8%
Electrical/Electronic	3.8
Mechanical	2.9
Other Engineers	2.5
Civil	1.8
Chemical	1.3
Industrial	-2.9
All Engineers	2.5

Overall, the relatively rapid growth in employment levels within the electrical and electronic engineering occupation over this period suggests a high demand for this type of engineer. This demand could signal a possible shortage situation, especially if there were constraints on the supply of newly trained engineers or high attrition from the field (e.g., because of retirements).

Exhibit 5.4: Employment of Electrical Engineers and All Engineers, 1983-1990

	Employment		*Percent Change*	
Year	Electrical Engineers	All Engineers	Electrical Engineers	All Engineers
1983	450,000	1,572,000		
1984	491,000	1,628,000	9.1%	3.6%
1985	544,000	1,683,000	10.8%	3.4%
1986	550,000	1,747,000	1.1%	3.8%
1987	545,000	1,730,000	-0.9%	-1.0%
1988	573,000	1,804,000	5.1%	4.3%
1989	571,000	1,824,000	-0.3%	1.1%
1990	581,000	1,863,000	1.8%	2.1%
Average			3.7%	2.5%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

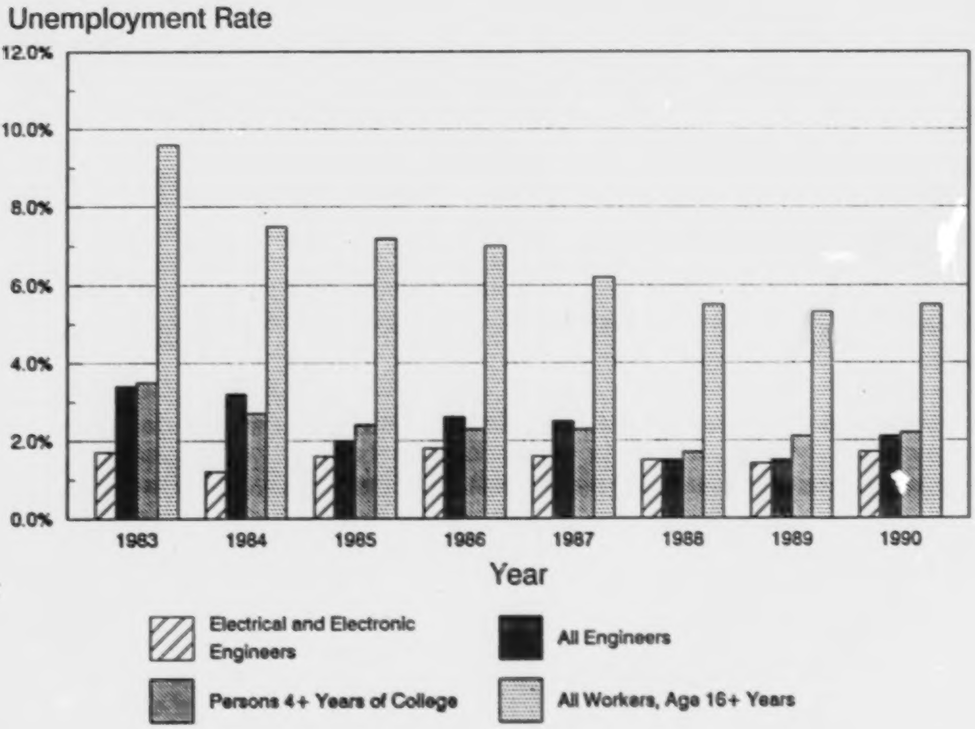
2. Occupational Unemployment Rates

As illustrated in Exhibit 5.5, the unemployment rate for electronic and electrical engineers -- like most other branches of engineering -- is well below the average for all workers in the United States and is somewhat below that of persons with four or more years of college. For example, in 1990 the unemployment rate of electrical and electronic engineers was 1.7 percent, compared to 5.5 percent for all workers 16 years of age or older, and 2.2 percent for all workers 25 years of age or older with four or more years of college. Over the past eight years (1983 and 1990), the unemployment rate for electrical and electronic engineers has been very low (e.g., not exceeding 1.8 percent) and relatively stable. Throughout this period, the unemployment rate has been consistently well below that of the labor force as a whole (e.g., by as much as 7.9 percent lower in 1983). While consistently lower than the unemployment rate for persons with four or more years of college, the differences are less (e.g., the greatest difference was 1.8 percent in 1983) and have narrowed in recent years. Overall, between 1983 and 1990, the unemployment rate for electrical and electronic engineers averaged 1.6 percent compared to 6.7 percent for all workers and 2.4 percent for workers with four or more years of college.

The unemployment rate for all branches of engineering (an average of 2.1 percent between 1983 and 1990) was substantially below the rate for the U.S. labor force. For example, from 1983 and 1990, none of the branches of engineering experienced unemployment greater than 3.8 percent (compared to an annual average of 6.7 percent for the U.S. labor force). In contrast to other branches of engineering, the unemployment rate for electrical and electronic engineers was relatively low:

Exhibit 5.5: Unemployment Rate for Electrical Engineers, All Engineers, College Graduates, and All Workers Over Age 16: 1983-1990

Year	Electrical Engineers	All Engineers	Persons 4+ Years of College	All Workers 16+ Years
1983	1.7%	3.0%	3.5%	9.6%
1984	1.2%	2.6%	2.7%	7.5%
1985	1.6%	1.9%	2.4%	7.2%
1986	1.8%	2.3%	2.3%	7.0%
1987	1.6%	2.3%	2.3%	6.2%
1988	1.5%	1.5%	1.7%	5.5%
1989	1.4%	1.5%	2.1%	5.3%
1990	1.7%	1.9%	2.2%	5.5%
Average	1.6%	2.1%	2.4%	6.7%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

Engineering Branch	Average Unemployment Rate (1983-1990)
Aerospace	1.3%
Electrical/Electronic	1.6
Chemical	1.6
Mechanical	2.0
Civil	2.5
Industrial	2.6
Other Engineers	2.9
All Engineers	2.1

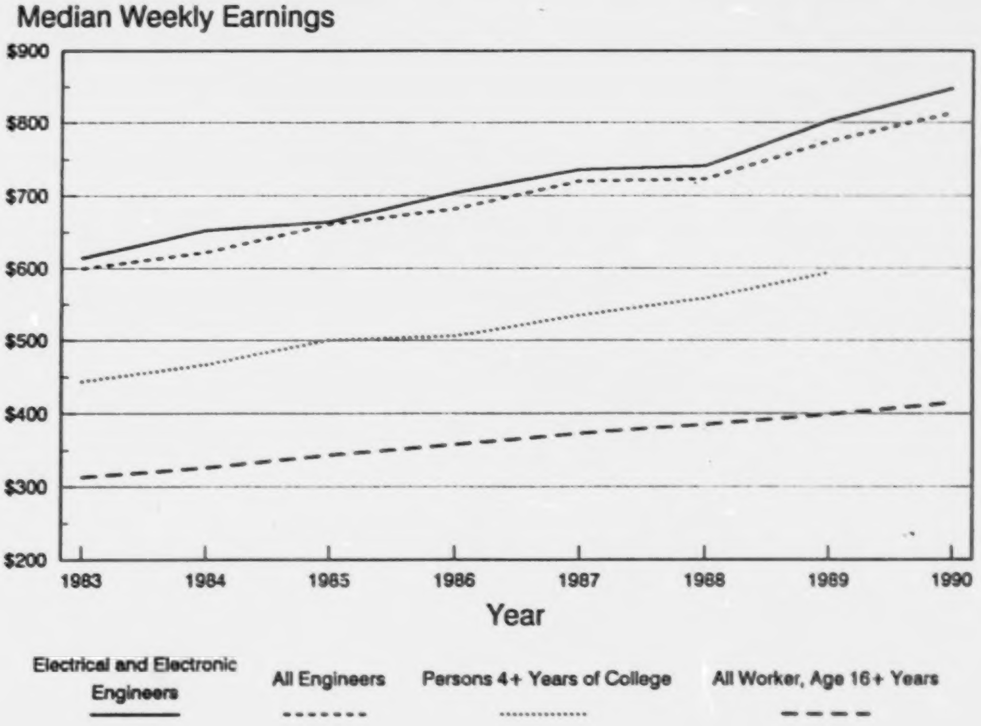
Other things being equal, most analysts would consider the relatively low unemployment rate for electrical and electronic engineers (in the range of 1.2 percent to 1.8 percent between 1983 and 1990), as an indicator of potential shortages within this occupation. For example, of the 193 occupations that Cohen examined in 1989, only 38 had an unemployment rate under 1.6 percent. While the relatively low unemployment rate for electrical and electronic engineers is an indication of "tightness" within the labor market, it is not in itself sufficient proof that shortages exist.

3. Earnings Trends

As mentioned in Chapter 2, the rate at which wages rise within an occupation is often viewed as the clearest indication of whether a shortage of workers exists (at least over the short-term). Rapidly rising wages within an occupation are generally viewed as a signal that at least a temporary imbalance exists between the labor supply and demand. Exhibit 5.6 shows median weekly earnings for electrical and electronic engineers from 1983 to 1990. This exhibit demonstrates that earnings for electrical and electronic engineers were consistently much higher than the average for the U.S. labor force and individuals with four or more years of college. For example, in 1990 the median weekly

Exhibit 5.6: Median Weekly Earnings, Electrical Engineers, All Engineers, College Graduates, and All Workers Over Age 16: 1983-1990

Year	Electrical Engineers	All Engineers	Persons 4+ Years of College	All Workers 16+ Years
1983	$614	$600	$444	$313
1984	653	622	467	326
1985	664	661	501	343
1986	704	682	507	358
1987	736	720	535	373
1988	741	723	559	385
1989	803	775	594	399
1990	848	814	618	415



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

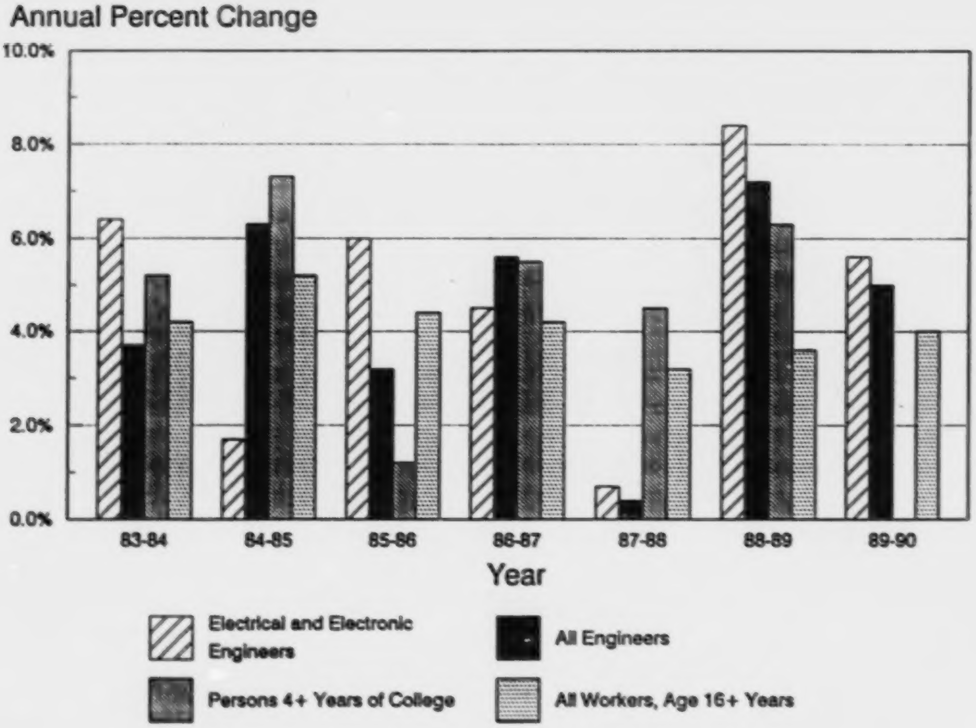
earnings for electrical and electronic engineers were $848, compared to $415 for all workers age 16 and older and $594 for persons age 25 and older with four or more years of college. Wages of electrical and electronic engineers were also somewhat above the average for all engineers (e.g., in 1990, the median weekly earnings for all engineers were $814). Among the major branches of engineering, only chemical engineers earned more in 1990:

Engineering Branch	Median Weekly Earnings (1990)
Chemical	$ 890
Electrical/Electronic	848
Aerospace	830
Mechanical	805
Civil	790
Engineers, NEC	768
Industrial	764
All Engineers	814

While the median weekly and lifetime earnings of electrical and electronic engineers were relatively high compared to other U.S. workers, the rate of change in earnings is generally considered to be a more reliable indicator of whether shortages exist within an occupation. Exhibit 5.7 points out the change in median weekly earnings for electrical and electronic engineers compared to all U.S. workers (16 years of age or older), persons with four or more years of college, and all engineers. This exhibit shows that median weekly earnings for electrical and electronic engineers increased by 4.7 percent on an annual basis over the eight-year period. This is somewhat above the median average for all U.S. workers (4.1 percent), but below that for all persons with four or more years of college (4.8 percent). The average annual change in median full-time wages for electrical and electronic engineers was marginally above the average for all engineers, but below those of several engineering branches:

Exhibit 5.7: Change in Median Weekly Earnings, Electrical Engineers, All Engineers, College Graduates, and All Workers Over Age 16: 1983-1990

Year	Electrical Engineers	All Engineers	Persons 4+ Years College	All Workers 16+ Years
83-84	6.4%	3.7%	5.2%	4.2%
84-85	1.7%	6.3%	7.3%	5.2%
85-86	6.0%	3.2%	1.2%	4.4%
86-87	4.5%	5.6%	5.5%	4.2%
87-88	0.7%	0.4%	4.5%	3.2%
88-89	8.4%	7.2%	6.3%	3.6%
89-90	5.6%	5.0%	4.0%	4.0%
Average	4.7%	4.5%	4.8%	4.1%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

Engineering Branch	Average Annual Change in Median Weekly Earnings (1983-90)
Industrial	5.4%
Chemical	5.2
Electrical/Electronic	4.8
Civil	4.8
Mechanical	4.4
Aerospace	4.0
Engineers, NEC	3.5
All Engineers	4.5

Between 1983 and 1990, earnings for electrical and electronic engineers increased by an average annual rate of 0.8 percent after inflation. Overall, in real terms, wages moved from $614 in 1983 to $646 in 1990 (in 1983 dollars), an increase of 5.2 percent over the eight-year period. The average annual increase in wages (in real terms) was slightly above that of all engineers (0.5 percent) and all workers (0.2 percent), but below that of all workers with four or more years of college (1.2 percent). The real increase in earnings for electrical and electronic engineers was somewhat below that of industrial and chemical engineers:

Engineering Branch	Average Annual Change in Inflation-Adjusted Median Weekly Earnings (1983-90)
Industrial	1.4%
Chemical	1.2
Electrical/Electronic	0.8
Civil	0.8
Mechanical	0.5
Aerospace	0.1
Engineers, NEC	0.4
All Engineers	0.5

D. Factors Contributing to a Labor Shortage

1. Presence of a Shortage

a. Current Labor Market Conditions

There is a general consensus among most employers and labor market analysts that while there may be some spot shortages (i.e., in emerging fields, specialty areas, and perhaps some localities), there is not a current shortage of electrical or electronic engineers. In fact, with the recent cutbacks in defense spending coupled with the slowdown in the economy, there have been recent layoffs within the field during the past year. The following comments from the interviews conducted for this report reflect the general consensus about the apparent absence of shortages of electrical and electronic engineers at the present time:

> **Director of the Manpower Division of a Major Engineering Society.** There are no current shortages for electrical and electronic engineers. The market for this type of engineer has been soft for the last couple years. There are probably some shortages in some emerging technology areas such as optical electronics, and special interest areas such as the environment, but these type of shortages always exist and are not true shortages.
>
> **Personnel Recruiter from a Major Employer of Electrical and Electronic Engineers.** There are lots of job applications from electrical and electronic engineers -- no shortages. The real problem we face is in finding recruits with computer science backgrounds. We have double the applications for electrical and electronic engineers compared to programmers.
>
> **Manpower Analyst Specializing in the Field of Electrical and Electronic Engineers.** There are no current shortages of electrical and electronic engineers. If anything, there appears to be a surplus of engineers because of the slack economy and cutbacks in the defense industry. Because of the forces of supply and demand within a free market economy, shortages cannot last for long. Only within a command economy or a market-based economy with wage and price controls do such shortages occur. There have not been real shortages of engineers since controls were placed on the U.S. economy during World War II.
>
> **Director of a Job Placement Office for a Major Engineering School.** There has been a recent slowdown in the demand for engineers, but demand for electrical and electronic engineers is spread across many employment sectors. Most electrical and electronic engineering graduates will find jobs within engineering. An indication

> that there have not been shortages in recent years is that inflation-adjusted salaries for electrical and electronic engineers have not moved up much since 1970 and salaries for Ph.D.'s are actually lower (after inflation) than in 1970. Employers are not visibly eager to hire new graduates; they have not raised wages to counter any obvious shortage.

Not a single interviewee -- which included over 20 individuals from business, government, and various engineering organizations -- indicated that there was a current shortage of electrical and electronic engineers. Most characterized the market for electrical and electronic engineers as basically in equilibrium. In comparison to the 1980s, which were characterized by very low levels of unemployment within the electrical and electronic engineering field, most analysts feel that the demand for new entrants is currently somewhat weaker, though most engineering graduates are still likely to find employment within engineering. For example, according to one manpower analyst we interviewed:

> ...The demand for engineers has been affected recently by both defense cutbacks and the recession. Firms are not sending the recruiters to the campuses like they have in the past -- they are not beating the bushes for engineers.

Most analysts feel that the clearest indications of an adequate supply of electrical and electronic engineers to meet current manpower requirements are provided by the following:

- **Slow Real Wage Growth:** There has been little upward pressure (relative to inflation) on either starting salaries or the salaries of existing electrical and electronic engineers in recent years.
- **Recent Layoffs:** The recession and defense-related cutbacks have resulted in some layoffs of electrical and electronic engineers recently.

A recent "Special Report on Engineering Careers" by the Institute of Electrical and Electronic Engineers, Inc. (IEEE), focused particularly on the impact of the recession and defense-related cutbacks on employment trends within electrical and electronic engineering:

> ..Over the past year in the United States, nearly a quarter of a million engineers and other employees in high-tech companies have lost their jobs. An undetermined number were electrical engineers. Hardest hit have been big computer and aerospace companies. Widely publicized defense cutbacks are only part of the story. In the general civilian economy, layoffs have resulted from company mergers and decreases in the market demand for certain major electronic products (such as microcomputers)...And since late 1989, based on leading economic indicators, the IEEE's Engineering Manpower Committee has been projecting that the employment outlook for electrical and electronic engineers will grow worse before it gets better, hitting bottom early next year.[30]

Some researchers feel that talk of shortages (either current or into the future) is primarily driven by self-interest on the part of employers and universities. For example, one engineering manpower specialist we interviewed saw the term "shortage" as a "promotional word, used to influence politicians to open the flood gates for immigration of scientists and engineers, and to con kids into the engineering field." According to this analyst, by stressing current or future shortages:

- universities gain because they can maintain and even expand the size of their engineering programs, which receive considerable public subsidies; and
- employers gain because shortages encourage individuals to enter engineering programs and provide a rationale for expanding immigration of foreign-trained engineers, which both serve to keep wages from escalating.

b. Future Labor Market Conditions

Despite the current conditions, there are demand- and supply-side factors that have created major concerns over the potential for future shortages of electrical and electronic engineers. Some researchers feel that these shortages are likely to emerge relatively soon (as early as the mid-1990s). In particular, they point to the very strong level of demand for this group of engineers and an anticipated sharp decline in the number of new graduates from engineering programs. Analysts such as Atkinson predict that unless something is done in the near future to stimulate the production of B.S. and Ph.D. level degrees in engineering, there will be a severe shortfall of engineers beginning in about 1995:

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[30] T. Bell (December 1990). "Special Report: Engineering Careers: '90s Employment: Some Bad News, But Some Good." The Institute of Electrical and Electronic Engineers, Inc., (IEEE) Spectrum, p. 32.

> ...Prudent assumptions, based on demographic data and historical trends, indicate that there may be a cumulative shortfall of several hundred thousand scientists and engineers at the baccalaureate level by the turn of the century. That shortfall could translate into an annual supply-demand gap of several thousand scientists and engineers at the Ph.D. level, with shortages persisting well into the 21st century... Unless corrective actions are taken immediately, universities, industry and government will begin to experience shortages of scientists and engineers in the next 4 to 6 years, with shortages becoming significant during the early years of the next century.[31]

Other researchers take a more cautious view of the future balance between supply and demand, but feel that trends need to be carefully monitored. For example, a manpower expert we interviewed at the Office of Scientific and Engineering Manpower warns:

> ...With regard to the future, it's important to watch closely and be concerned, but evidence does not suggest that it is time now to push the panic button with regard to shortages.

Still other analysts are skeptical about the likelihood of shortages, arguing that the forces of supply and demand will eliminate long-term shortages:

> ...We've been hearing recently from various sources that the United States will experience a shortage of engineers by about the year 2000. Based on the information that's available to make accurate employment forecasts, I think this prediction simply is not true. The fault with many of these employment predictions is that they look only at the supply of engineers without attempting to forecast demand, which is the more difficult side of the equation.[32]

The next two sections examine demand- and supply-side factors that are likely to effect whether future shortages occur.

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[31] Atkinson (1990), p. 427.

[32] E. Bertnolli (April 1989). "Engineering Supply -- Does It Meet the Demand?" The Institute for Electrical and Electronic Engineering, Inc.

2. Demand-Side Factors

Strong demand for electrical and electronic engineers, increasing levels of replacement demand (primarily resulting from retirements), and the demand for engineers in sub-specialty areas of the field are three demand-side factors that are likely to influence future labor market conditions.

a. Projected Employment Growth from 1988 to 2000

The outlook for electrical and electronic engineers appears to be one of relatively rapid growth through the end of the century. Strong growth in employment is based on an assessment that the market for electronic and electrical products (e.g., computers, robotics systems, etc.) will continue to grow at a rapid pace. BLS has projected an annual rate of employment growth of 2.8 percent for electrical and electronic engineers -- over double the average for all occupations (1.2 percent).[33] This rate of employment growth is quite high compared to most other occupations -- only 15 out of 193 occupations have a rate of growth projected to be the same or greater than that for electrical and electronic engineers. The rate of projected growth in employment for the occupation is also substantially above that for all other branches of engineering. With the exception of "other" engineers (1.9 percent), all other engineering fields have projected annual growth rates of between 1.0 and 1.5 percent. According to the Occupational Outlook Handbook:

> ...Employment opportunities for electrical and electronic engineers are expected to be good through the year 2000 because employment is expected to increase much faster than the average for all occupations. Despite the rapid growth, however, the majority of job openings will result from the need to replace electrical and electronics engineers who transfer to other occupations or leave the labor force.[34]

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[33] This rate of increase is for the 193 occupations examined by Cohen.

[34] Occupational Outlook Handbook, p. 403.

Some analysts, however, have questioned whether employment growth will be as strong as predicted by the BLS. In particular, long-term growth in employment within the field of electrical and electronic engineering may be affected by several factors:

- **Recession:** The extent and duration of the 1990-91 recession is likely to affect the demand for electrical and electronic products -- which, in turn, will affect the demand for engineers.
- **Defense Cuts:** At the present time, an estimated 10 to 20 percent of the country's engineers are involved in defense-related work.[35] Already the defense cutbacks have led to layoffs of electrical and electronic engineers and more of these cutbacks are expected in the future.
- **Foreign Competition:** Growth in electrical and electronic engineering jobs will depend, in part, on the extent to which foreign-produced goods make inroads into domestic markets and the strength of exports of electronic goods and services. This, in turn, will depend on whether the United States can continue to hold its technological edge in certain areas of electrical and electronic engineering, currency exchange rates, and import and export restrictions.
- **Advances in Technology:** There have been many recent advances in the tools used by engineers to design and test new products (e.g., computerized work stations). These new tools are designed to improve the productivity of workers and, in some instances, may permit the substitution of less skilled manpower (e.g., technicians) for some engineering tasks. It is uncertain, at this time, whether rapid advances in these technologies will increase or reduce the number of electrical and electronic engineers that are needed.

Further, there is a consensus that future demand is more difficult to predict than supply. Some observers would argue that demand projection by occupational group is mostly guess work. For example, Bertnolli of the Institute of Electrical and Electronic Engineers asserts:

> ...Predicting demand is a much more complex situation. The United States maintains no "official" index of demand for engineers, but various public and private sector organizations publish indicators of current and future demand that are

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[35] Pool (1990), p. 433.

> considered reasonably reliable. Specific data, however, on electrical, electronics and computer engineers are not always available.[36]

Overall, despite the uncertainty of predicting long-term demand trends for occupations, the picture for the electronic and electrical engineering field is one of continued growth.

b. Replacement Demand

In any given year, workers leave a particular occupation for a variety of reasons -- illness, death, retirement, or to enter a new profession. High rates of turnover -- i.e., the need to replace workers -- within an occupation may signal (though certainly not prove) the potential for shortages. There is particular concern over whether there is an adequate number of new engineers within the pipeline to replace the large number of electrical and electronic engineers (hired for the space and defense programs during the 1960s) who are expected to retire during the 1990s and early in the next century.

While the annual replacement demand for electrical and electronic engineers is comparable to that of other engineering fields, and in the lowest quartile of all occupations in 1986, it is expected to sharply increase in the early 1990s because of retirements. For example, the National Science Foundation has identified growing retirements as one of two factors[37] that are likely to alter the balance between supply and demand for natural scientists and engineers:

> ...The second event is an anticipated doubling of the replacement demand for Ph.D. level natural scientists and engineers during 1990-2006, as a consequence of the large number of Ph.D.'s hired during the 1960s.[38]

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[36] E. Bertnolli (1989).

[37] The second factor is the decline in the size of the college-age population.

[38] Future Scarcity of Scientists and Engineers: Problems and Solutions, p. 3.

According to estimates by Rivers:[39]

> The 1990s from 1992 on will have a Deaths and Retirements replacement demand of approximately 2.5 percent of the engineering population or between 39,000 and 45,000 per year depending upon the engineering population used with the larger figure based upon the BLS household survey of the engineering population.

This increase in replacement demand is principally due to increases in retirements beginning in 1992. Rivers estimates that the retirement rate for engineers will increase from 0.81 percent in the period 1988 to 1991 to about 2 percent beginning in 1992 and lasting through the rest of the decade. Holding demand constant, this increase in retirements suggests the need for a countervailing increase in entrants to the occupation (e.g., through new graduates, immigrants, transfers, or upgrades).

c. Spot Shortages in High Demand and Emerging Specialty Areas

Finally, while there may not be generalized shortages of electrical and electronic engineers, some employers and analysts point to the existence of "spot shortages" within either "hot" research areas or newly emerging technical areas. For example, with the concentration of the federal government on the Strategic Defense Initiative (SDI) during the late 1980s, there was intense competition for engineers with experience in optical electronics. One recent article pointed to problems with locating engineers in the emerging specialties within the aerospace industry:

> ...Boeing, like other major aerospace firms, is having more difficulty recruiting engineers who are trained and experienced in emerging technologies than in finding entry-level personnel. Advanced composite materials, stealth technology, robotics, artificial intelligence, computational fluid dynamics and electronics are some of the more salient technology areas where engineering expertise is in constant or increasing demand throughout the aerospace industry.[40]

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[39] R. Rivers (1990). "Death and Retirement Effects on Engineering Supply," Engineering Manpower Newsletter.

[40] Kandebo (1988), p. 46.

According to one labor market expert interviewed for this report there are likely to always be shortages in some areas of electrical and electronic engineering: "Because there are always emerging technologies and fields within electrical and electronic engineering, there will always be some quasi-shortages of manpower."

3. Supply-Side Factors

The supply of employed electrical and electronic engineers is made up of persons already trained and in the labor force, along with new additions to the labor market. In particular, the adequacy of the future supply of electrical and electronic engineers is expected to be affected by the following:

- new graduates at all degree levels;
- immigration of previously trained engineers from other countries;
- transfers into the field from other closely related professions, such as other engineering specialties, computer science, mathematics, physics, and chemistry; and
- upgrading non-degree technicians who are promoted into the field of electrical and electronic engineering on the basis of their experience.

All four of these factors represent ways in which to increase supply to meet increasing employment demand and to replace workers who leave the occupation. The key concern for many analysts is whether these four sources of supply -- particularly new graduates -- will generate a sufficient number of new entrants to meet the expected strong demand for workers within the occupation.

a. New Graduates at All Degree Levels

According to the National Science Foundation, the "dominant factor" affecting the supply of new natural science and engineering B.A. and Ph.D. graduates is the declining size of the college-age population:

> ...The key event is a 25 percent reduction in the number of 'college age' students during 1983-1996 after a doubling during 1961-1979, as measured by the number of 22-year-olds.[41]

According to the National Science Foundation, the proportion of natural science and engineering degrees awarded annually has been a "relatively fixed fraction of the U.S. 22-year-old population for almost three decades." As a result of the baby-bust, the National Science Foundation and others predict a substantial decline in the number of engineering (B.S. and Ph.D.) graduates. In addition, the National Science Foundation asserts that the projected decline in the proportion of college students selecting natural science and engineering majors is an important secondary factor underlying the expected future shortfall. Overall, as discussed in greater detail earlier in this chapter, the National Science Foundation and others suggest that there will be a steep decrease in the production of engineers, resulting eventually in a shortfall of available engineers:

> ...During 1986-1998 a decline of 20 percent in the annual production of NS&E (i.e., natural science and engineering) degrees is expected, mirroring the reduction in the number of 22-year-olds estimated by Census. This drop is expected to recover partially during 1998 to 2003, as the number of 22-year-olds increases according to Census data estimates.[42]

b. Immigration of Foreign-Born Engineers

In order to meet specialized engineering needs and to supplement the general supply of electrical and electronic engineers, U.S. firms have increasingly employed foreign-born engineers. The number of foreign engineers increased from 95,000, or almost 8 percent of working engineers in 1972, to an estimated 395,000 or almost 19 percent in

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[41] Future Scarcity of Scientists and Engineers: Problems and Solutions, p. 3.

[42] Future Scarcity of Scientists and Engineers: Problems and Solutions, p. 8.

1982. Current estimates place the total at more than 25 percent.[43] According to the National Science Foundation, the proportion of foreign citizens enrolled full-time in electrical and electronic engineering graduate programs in the United States grew from 36 percent in 1977 to 47 percent in 1986. In 1987, non-U.S. citizens accounted for about one-half of the Ph.D.'s granted in electrical and electronic engineering.[44] Foreign-born students constituted a much smaller proportion of the U.S. engineering undergraduate enrollment -- earning typically less than 10 percent of all engineering bachelor's degrees awarded annually between 1975 and 1985 by U.S. educational institutions. The availability of foreign-born engineers increases the supply of electrical and electronic engineers, especially at the Ph.D. level at universities and specialties within the field. For example, according to the National Research Council, in 1985 almost half of all engineering faculty and engineering assistant professors under the age of 35 in U.S. universities and colleges were foreign-born.

One indication of the importance of foreign-born workers within an occupation is the number of labor certifications issued by the U.S. Department of Labor. In fact, Cohen argues that labor certifications as a percentage of total employment may be used "as an indicator of labor shortage under the assumption that immigrants are being certified because employers are unable to find U.S. workers in those occupations where large numbers of certifications are being made."[45] In 1988, the number of labor certifications within the electrical and electronic engineering branch were over 10 times as great as the average for all occupations in the United States (e.g., 352 per 100,000 versus 32 per 100,000 for the entire country). In fact only three other occupations (of the 193 occupations examined by Cohen) had a higher level of labor certifications.[46]

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[43] W. Wingo (June 5, 1989). "Engineers: Growing Demand, Short Supply: Changing Technology, Demographics Alter the Way Companies Select Engineers." Design News, p. 32.

[44] Profiles -- Electrical/Electronics Engineering: Human Resources and Funding, p. 33.

[45] Malcolm. S. Cohen (1990). Study on the Feasibility of Using Labor Market Information for Alien Certification Determination. Ann Arbor, Michigan: Institute of Labor and Industrial Relation, University of Michigan, p. 65.

Immigration of foreign-born engineers not only serves to fill employment positions for which there may be an inadequate number of U.S.-born engineers, but also provides for a more continuous supply of engineers. For example, according to a manpower analyst interviewed for this report:

> ...The availability of foreign-born engineers makes the flow of engineers to firms more fluid. In the past, there was a lag, with engineers graduating in June and being picked up shortly thereafter by firms. Firms would then wait until the next class graduated. But now it is possible for firms to bring in foreign-born engineers throughout the year to meet specific needs. Therefore, the supply is more continuous now and better matched to the demand and specific needs of employment.

The 1965 immigration law was especially important in increasing the flow of engineers to the United States, because it liberalized rules with regard to firms certifying engineers to immigrate to America. There are, however, still a number of barriers that foreign-born graduates of engineering programs in the United States must overcome before they may become permanent employees of U.S. firms. Before hiring a non-U.S. citizen, employers must convince the Immigration and Naturalization Service that the engineer has "distinguished merit and ability." Should this worker next apply for a permanent resident visa, the company must show the Department of Labor that it has advertised the position and cannot find a more qualified candidate.[47]

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[46] These are painters, sculptors, craft-artists, and artist-printmakers (1,022 per 100,000); other professional specialty occupations (668 per 100,000); and other precision textile, apparel, and furnishings machine workers (385 per 100,000).

The improvement of telecommunications and the growing internationalization of the market for skilled manpower may also help to alleviate future shortages, should they arise. For example, one labor market analyst asserted that with improvements in telecommunications (e.g., fax machines and computer networks) it is now relatively easy for business to contract out to engineers in other countries work that in the past would have been done by engineers in the United States:

> ...The electrical and electronic engineering field has become increasingly internationalized in recent years. There are now many multinationals that are contracting work to engineers in other countries. For example, a company might contract out software development to an engineer in India, and communicate across telephone lines.

By utilizing an engineer in Europe or India, for example, a U.S. firm may be able to obtain expertise that it is unable to find domestically. Further, such an arrangement may provide a substantial reduction in production costs -- especially where wages are substantially below those paid to domestic engineers.

Hence, immigration of foreign-born engineers (both for study at U.S. universities and to work for American firms) serves to increase the availability of electrical and electronic engineers within the country. In recent years, this has particularly been a factor that has affected the supply of Ph.D. candidates to fill faculty positions at universities in the United States.

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[47] The recent enactment of the 1990 immigration law by Congress is expected to ease some of these barriers, most likely further increasing the flow of foreign-born engineers to the United States.

c. Transfer and Upgrading of Engineers

Finally, three other factors tend to provide a cushion against an inadequate supply of electrical and electronic engineers:

- **Upgrading of Technicians.** Technicians and other workers can be upgraded to fill engineering positions based on experience. For example, technicians with two-year associate degrees may be upgraded to fill engineering positions. Alternatively, technicians may be used to perform some of the tasks normally done by engineers.

- **Transfers from Other Related Fields.** There is an ability for workers trained in other scientific areas to cross over to fill vacancies in engineering. According to the National Research Council there is increasing reliance within the engineering field on "residual sources." Primary residual hiring focuses on degrees in mathematics, physics, and chemistry. The National Research Council reports that the number of employed engineers with degrees in non-engineering fields rose from about 130,000 or 15 percent in 1972, to more than 400,000, or 20 percent in 1982. According to some personnel experts, this percentage could now be as high as 30 percent.[48]

- **Reserve Pool of Engineers.** Some of those trained in electrical and electronic engineering never go into the field or fail to land a job within the occupation because of economic conditions. These individuals serve as a reserve that can be called upon should the market become tight. For example, of the 89 percent of 1984 and 1985 electrical/electronics engineering baccalaureate recipients employed in 1986, 20 percent were in other science or engineering fields and 7 percent were employed outside of engineering. In addition, of those graduates, 3 percent remained unemployed in 1986.[49]

E. Adjustments to Shortages by Employers

As discussed in Chapter 2, there is a range of strategies that employers can use to adjust to or alleviate the effects of shortages of labor. Some of the adjustments that employers (e.g., electronics firms, defense contractors, and universities) have used in the past or that are planned to deal with what are expected to be shortages in the future are examined below. Potential government and educational responses to future shortages are discussed in the final section of this chapter (under recommendations).

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[48] Wingo (1989), p. 32.

[49] Profiles -- Electrical/Electronics Engineering: Human Resources and Funding, p. 37.

1. Increase Recruiting Efforts

A logical first step for firms facing shortages of electrical and electronic engineers involves intensifying or targeting recruitment efforts. In response to generalized shortages of engineers, businesses may need to intensify existing efforts or perhaps initiate new recruitment approaches. Traditionally, engineering firms have focused their recruitment efforts -- particularly for entry-level engineers -- by building strong linkages with engineering colleges and universities. For example, employers might expand the number of engineering schools to which they send company representatives, or they may increase the number of visits that their representatives make to these schools. To fill vacant positions in emerging technological areas (e.g., stealth technology and robotics), employers might target certain universities that have specialized graduate training in these areas.

Attracting more experienced engineers, especially in emerging technological areas, is more difficult. Companies can intensify their recruitment efforts through advertising in professional journals, computer bulletin boards, and newspapers. Firms may increase efforts through expanded use of employment agencies. Alternatively, businesses may expand the geographical scope of their recruiting efforts. For example, a medium-sized engineering firm in New England might expand their search to other regions of the country. Many engineering firms are increasingly relying upon recruitment of foreign-born engineers. Finally, firms might employ entirely new approaches. For example, an aircraft company that was experiencing shortages of mid-level engineers introduced several new recruiting techniques: (a) providing employment opportunities for spouses of engineers, (b) increasing use of hiring bonus programs, and (c) improving relocation benefits.[50]

2. Hire from the Ranks of Non-Engineers or Upgrade Technicians

As mentioned earlier, the number of new engineers in the pipeline has decreased in recent years (because of the end of the baby boom) and engineering firms have increasingly turned to non-engineers and the upgrading of engineering technicians to fill engineering positions. Hiring personnel from non-engineering fields -- especially individuals with degrees in mathematics, physics, and chemistry -- has increased considerably over the past two decades. Within the electrical and electronic engineering occupation, firms have particularly concentrated recruitment on computer scientists. Another source of electrical and electronic engineers has been the upgrading of experienced technicians. The U.S. workforce has an estimated one million technicians from which to draw. In upgrading technicians, it may be necessary for firms to provide workers with additional education and training.

3. Use Retirees to Fill Part-Time or Temporary Engineering Positions

As discussed earlier, a major problem for engineering firms and universities during the 1990s is expected to center on filling vacancies created by the retirement of existing engineers. Many firms that employ large numbers of engineers have already taken steps to minimize the effects of retirement. Firms emphasize the importance of anticipating "block retirements" and planning ahead to fill positions. Some examples of these efforts include:

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[50] Kandebo (1988).

- General Electric, like other aerospace companies, employs retired engineers on a part-time basis when its work load becomes too heavy. The company also uses retirees for special temporary projects that require their particular skills or knowledge.

- Pratt and Whitney rehires retired personnel on a temporary basis, providing them with short work weeks as an extra incentive.

- Hughes Aircraft makes a concerted effort to transfer specialized skills and knowledge before it is lost.[51]

4. Substitute Equipment for Labor

Recent advances in computer-aided design and engineering, expert systems, and computer-integrated manufacturing have had a substantial effect on the manpower requirements and the nature of engineering work. The tools that engineers use have been greatly expanded -- especially in the area of computerized tools. For example, computer workstations, linked directly to numerically-controlled machines, are increasingly replacing nearly all drafting tables that were once a key design component. CD-ROM disks at engineering workstations provide engineers with instant access to an enormous collection of data (in text, graphics, and even sound). CAD/CAM makes it possible to customize hand-made mass production.[52] Increasing use of automated systems has several important implications for manpower requirements of electrical and electronic engineers. First, such technology is designed to improve productivity of existing engineers -- hence, it may somewhat reduce the need for additional manpower. Second, it may expand the capabilities of existing engineers, perhaps reducing the need for hiring specially-trained labor. Third, it may somewhat lessen the manpower requirements for some tasks, enabling firms to substitute either non-engineers or to upgrade technicians to perform tasks previously done by engineers.

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[51] Kandebo (1988), p. 53.

[52] Wingo (1989), p. 32.

5. Train Workers to Enhance Engineering Skills

Two problems that firms often face in the rapidly changing field of electrical and electronic engineering are (a) obsolescence of skills and (b) locating manpower in emerging sub-specialties. As a result, many firms provide workers with both on-the-job training and educational benefits that can be used to upgrade engineering knowledge or skills. Firms may pay part or all of the cost of continuing education for their workforce. One problem in offering such benefits, however, is that firms may not be able to recoup the costs of the training. For example, individuals receiving such training or education may move to another employer shortly after training is completed.

6. Improve Utilization of Existing Engineers

Some analysts have suggested that effective utilization of existing engineers would help to alleviate shortages. While many firms effectively utilize the time, knowledge, skills, and judgement of their engineers, there are some instances where engineers are either under-utilized or used in sub-engineering tasks. For example, the Institute of Electrical and Electronic Engineers, Inc. argues: "The nation's competitiveness and productivity can be substantially increased through proper utilization of the time and skills of its engineering professionals."

7. Contract Work Out

Certain technological advances -- particularly in communications and computerized workstations -- have enabled firms to increasingly contract work out to other geographic locations. For example, firms can now easily contract with engineers in other regions of the country and internationally to perform engineering tasks. This is particularly helpful in gaining access to engineers with experience in sub-specialties and emerging technologies.

8. Increase Wages and Fringe Benefits

As discussed earlier in this chapter, the earnings of electrical and electronic engineers have increased at about the same rate as earnings in other fields in the United States in recent years. Hence, general increases in wages and fringe benefits have not been used to any large degree by firms to increase the supply of engineers. However, improved wages and fringe benefits have been used by employers to recruit engineers with sub-specialties (especially in new technological areas for which few engineers are trained) and to entice experienced engineers to change firms.

F. Conclusions and Recommendations of Public and Private Sector Steps to Alleviate Shortages

1. Conclusions

There is a general consensus that while there may be some spot shortages (i.e., in emerging fields, specialty areas, and perhaps some localities), there is not a current shortage of electrical or electronic engineers. In fact, with the recent cutbacks in defense spending coupled with the slowdown in the economy, there have been layoffs within the field during the past year. Engineering school job placement programs and employers report less intensity in their recruitment activities. There has been little upward pressure (relative to inflation) on either starting salaries or the salaries of existing electrical and electronic engineers in recent years.

Despite the current conditions, there are demand- and supply-side factors that have created concerns over the potential for future shortages of electrical and electronic engineers. Some observers feel that these shortages are likely to emerge relatively soon (as early as the mid-1990s). In particular, they point to the very strong level of demand for this group of engineers and an anticipated sharp decline in the number of new graduates from engineering programs. Analysts such as Atkinson predict that unless something is done in the near future to stimulate the production of bachelor's and Ph.D. degrees in engineering, there will be a severe shortfall of engineers beginning in the mid-1990s.

2. Recommendations

There is a considerable range of opinion on what steps should be taken to reduce the likelihood of future shortages of engineers. Some analysts contend that the best thing for the government to do is simply nothing at all. This line of argument views the market for engineers as being relatively free (compared, for example, to the market for home health care workers, where wages for workers are substantially influenced by government regulations), with many employers competing for the services of engineers, and relatively good information available on employment opportunities and wages available to workers. It is argued that over time the market will gradually work to eliminate any shortages that might occur (e.g., by increasing wages). Given these circumstances, government should do what it can to ensure that the labor market works efficiently. For example, the government should ensure that all of those involved in the market (both workers and employers) have the necessary information to make informed decisions about employment or engineering occupations.

Other analysts feel that there are a variety of steps that the government, educational institutions, and employers need to implement in the next few years to ensure an adequate supply of engineers. These researchers maintain that active steps need to be taken given (a) the decreasing supply of college students, (b) the increasing level of retirements among existing engineers, and (c) the expected continuing growth in the demand for electrical and electronic engineers. The National Science Foundation, for example, contends that occupational shortages in science and engineering fields can be remedied through two basic strategies:

- **Attraction:** More qualified individuals need to be attracted into the natural science and engineering fields. Attraction strategies seek to increase the number and quality of students who are interested in science and math by the time they reach high school. Such efforts focus on teaching methods that stress the interesting features of science and math. These strategies are most applicable during grades one through eight, and thereafter diminish in importance.

- **Retention:** Retention strategies are aimed at keeping a large number of individuals in the natural science and engineering pipeline. Retention strategies seek to maintain student interest at all levels of education and to strengthen the depth of learning without losing students through poor teaching, fear of complexity and abstract concepts, and financial need. These strategies are particularly applicable during secondary education and college.[53]

The sections that follow lay out major recommendations for government and educational institutions to both attract and retain a greater number of students to engineering fields.

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[53] Future Scarcity of Scientists and Engineers: Problems and Solutions, p. 25.

a. Improve Science Curriculum and Reduce Attrition of Able Students from the Natural Science and Engineering Pipeline Prior to College

The National Science Foundation has found a rapid constriction in the pool of natural science and engineering students during high school:

> ...In 1980, there were approximately 3,650,000 high school sophomores. Of these 700,000 had an interest in natural science and engineering and another 500,000 or so were not yet permanently out of the NS&E pipeline. However, only 260,000 had plans to attend a 4-year college and major in an NS&E field. High school age students are typically quite flexible in changing career intentions in response to new information and pressures. Only about 90,000 (35 percent) of the high school sophomores planning NS&E majors at 4-year colleges were still in the NS&E pipeline as high school seniors.[54]

An Office of Technology Assessment study found that more than half of those students interested in science and engineering careers as high school sophomores shifted their plans to other subjects by the time they reached their senior years. Analysts point to several problems that appear to foster disinterest in science and engineering coursework:

- Some studies have found that teachers tend to identify and encourage the best students to go on to the next level of math and science education, while discouraging those who appear to be neither the best nor the brightest.
- Another problem is the method of instruction: most science teaching in elementary and secondary educations consist of lectures and tests based on recall, which is unlike scientific work that is often based on experimentation.
- Poorly equipped labs or the absence of labs, as well as large class size, increase emphasis on book work rather than laboratory study.
- Teachers, particularly below the high school level, are often unqualified to teach sciences.[55]

Most researchers point to the need for better curriculum and teaching to keep students interested in the sciences. In addition, the fact that high school students are relatively flexible in their decisions concerning career intentions argues for enhanced career counseling.

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[54] Future Scarcities of Scientists and Engineers: Problems and Solutions, p. 18.

[55] Kandebo (1988).

There is also a concern over the relatively large group of students who successfully complete high school coursework with concentration in science and math, but fail to attend college. Statistics collected by the Department of Education tracking students from the high school class of 1980 found, for example, that about one-quarter of students who had not enrolled in any type of college program, had taken 20 or more semesters of mathematics and science in high school. Atkinson and others argue that the projected shortfall of scientists and engineers over the next two decades could be largely avoided if this group of students went on to college in science and engineering, even allowing for subsequent attrition.[56] To more effectively capture this group, it is generally recommended that financial assistance and counseling be targeted to them.

Finally, there is much concern over the very low proportion of minorities who are still within the engineering pipeline at the end of high school. Minorities -- especially blacks and Hispanics -- are more likely to drop out of high school before graduation and, even when they complete high school, are much less likely than their white counterparts to enter engineering and science programs at universities. Intensified efforts on the part of educational institutions (beginning in the grade schools) and government funding targeted on assisting minorities along the educational pathway are likely to be needed.[57]

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[56] Atkinson (1990), p. 430.

[57] The Health Career Opportunity Program, administered by the Health Service and Resources Administration (HRSA) of the U.S. Department of Health and Human Services, is an example of a federal initiative that provides funds for medical schools to prepare, recruit, and retain minorities within the health professions.

b. Reduce Attrition from Engineering Programs at the Undergraduate Level

Recent studies have also found that a large proportion of qualified and interested students are lost to science and engineering between their freshman and senior years of college. For example, only 46 percent of those freshmen who declare their intention to major in science or engineering eventually receive baccalaureate degrees in those fields. Of those freshmen who switched from engineering or sciences, only 31 percent did so because they found the coursework too difficult -- 43 percent found other fields more interesting.[58]

In response, the National Science Foundation and others stress the need for retention strategies aimed at reducing the high level of attrition from natural science and engineering studies at the undergraduate level. The NSF has identified four areas in which retention should be directed:

- ensure that all two-year and vocational college students have an opportunity to sample natural science and engineering curricula and to transfer to four-year colleges;
- convince freshmen not to switch from natural science and engineering into other programs;
- raise the graduation rate of women and minorities to that of majority men; and
- improve the quality of the teaching and the teaching environment in public colleges to that of private colleges.[59]

In order to retain college students, the NSF and others point to the importance of curriculum revision, expansion of teacher training programs, more effective college and career counseling, and increases in scholarship programs. For example, it is recommended that scholarship programs be targeted at students who lack the financial resources to attend college, but who have at least an A-/B+ average and at least 10 semesters of math and science in high school.

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[58] Atkinson (1990), p. 430.

[59] Future Scarcity of Scientists and Engineers: Problems and Solutions, p. 25.

c. Expand Financial Assistance for Post-Graduate Study

Many observers have also pointed to the need for increased production of Ph.D. recipients in the engineering field, especially in light of the expected increase in retirements of university faculty in the 1990s. Analysts generally point to the need for expansion in the number of scholarships for graduate study in natural science and engineering, as well as an increase in the stipend provided to students (perhaps as high as 50 percent of the starting salary for new bachelor degree holders).

d. Improve Data on Demand for Engineers

Beyond increased support for attracting and retaining students within the natural science and engineering pipeline, some analysts urge that the federal government work to improve the data that is available to individuals and firms on the labor market conditions for engineers. Special attention is needed to improve data on the current demand for engineers. For example, periodic collection of vacancy rate data from major employers of engineers, by field and sub-specialty, is needed to accurately anticipate potential shortages.

CHAPTER 6

CASE STUDY OF TOOL AND DIE MAKERS

A. Description of the Occupation

Tool and die makers are highly-skilled machinists who make tools, dies, and special guiding and holding devices that are used in machines to produce a variety of products -- from clothing and furniture to heavy equipment and aircraft parts. Working from blueprints or instructions from supervisors, tool and die makers craft precision tools that are used to cut, shape, and form metal and other materials. They produce jigs and fixtures (devices that hold metal while it is bored, stamped, or drilled), gauges, and other measuring devices. Tool and die makers also construct metal forms (i.e., dies) that are used to shape metal in stamping and forging operations. They make metal molds for diecasting and for molding plastics, ceramics, and composite materials. In addition, tool and die makers may repair worn or damaged tools, dies, gauges, jigs, and fixtures, and help design tools and dies. Of the 152,000 tool and die makers employed in 1990, most worked for small firms that manufactured tools and dies, metal working machinery, motor vehicles, aircraft, and plastics products.[1] [2]

According to the U.S. Department of Labor's Dictionary of Occupational Titles, a tool and die maker:

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[1] U.S. Department of Labor, Bureau of Labor Statistics (April 1990). Occupational Outlook Handbook: 1990-91. Washington D.C.: Bulletin 2350, p. 402.

[2] John D. Bell and Lonny D. Garvey (1986). Opportunities in the Machine Trades. Lincolnwood, Illinois: Published in cooperation with the National Tooling and Machining Association by the National Textbook Company, p. 37.

- analyzes specifications, lays out metal stock, sets up and operates machine tools, and fits and assembles parts to make and repair metal working dies, cutting tools, jigs and fixtures, gauges, and machinists' handtools, applying knowledge of tool and die designs and construction, shop mathematics, metal properties, and layouts, machining, and assembly procedures;
- studies specifications, such as blueprints, sketches, modes, and descriptions and visualizes products;
- computes dimensions and plans layout and assembly operations;
- measures, marks, and scribes metal stock for machining;
- sets up and operates machine tools such as lathe, milling machine, shaper, and grinder, to machine parts, and verifies conformance of machined parts to specifications.[3]

Tool and die makers plan the sequence of operations necessary to manufacture a tool or die. Tool and die makers measure and mark the pieces of metal that will be cut to form parts of the final product. They then do the cutting, boring, or drilling that is required. They check the accuracy of what they have done to insure that the final product will meet specification. Then they assemble the parts and perform finishing jobs such as filing, grinding, and smoothing surfaces. In shops that use numerically-controlled (NC) and computer numerically-controlled (CNC)[4] machine tools, tool and die makers' jobs may be slightly different. For example, although they still manually check and assemble the tool or die, each of its components may be produced on a NC or CNC machine. In addition, they often assist tool programmers in the planning and writing of NC programs.[5]

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[3] U.S. Department of Labor, Employment and Training Administration (1977). Dictionary of Occupational Titles. Washington, D.C.: Fourth Edition, p. 491-492.

[4] NC equipment requires the operator to punch or otherwise prepare a tape, feed it into the controls, position the piece to be machined, set the machine in motion, make the necessary adjustments, oversee the operation, measure or otherwise check the results, and, in general, be responsible for the machine, the controls, and the production. CNC requires the same procedures of the operator, but commands are issued by a computer.

[5] Occupational Outlook Handbook, p. 402.

This occupation is of considerable interest to labor market analysts for several reasons. First, although the demand for tool and die makers is expected to increase more slowly than the average for all occupations through the year 2000, the Bureau of Labor Statistics (BLS) notes that this occupation is already experiencing apparent shortages, which are expected to grow primarily because of an aging workforce:

> ...A relatively large proportion of tool and die makers are 50 years of age or older. Currently, employers in many locations are finding it difficult to attract enough qualified candidates and training program enrollments have not increased enough to satisfy the growing demand. As these older workers begin to leave the occupation, employers in certain parts of the country may face more pronounced shortages.[8]

If shortages exist in this occupation, they appear to be primarily a function of supply-side constraints, rather than prevailing wages or a high demand for services. Despite relatively high wages, the tool and die industry has had difficulty attracting qualified job applicants. Firms and experts have suggested that a variety of factors might lie behind perceived shortages of tool and die makers, including lengthy training periods, higher entry-level requirements than other manufacturing jobs, lack of job mobility, and an overall bias against blue-collar employment by potential entrants.

Tool and die makers provide an interesting contrast to the other occupations selected for the case studies in this report. Unlike the other occupations, tool and die makers are "blue collar" workers -- though highly-skilled, and well-paid blue collar workers. Second, these workers are an integral part of the manufacturing sector and are considered essential to the production of many manufactured goods in the United States, including the national defense. A shortage of qualified tool and die makers could affect the productive capability of U.S. manufacturers and be a factor in locating manufacturing plants abroad. Third, it is a profession with low turnover -- workers have strong attachment to their jobs because of the long training period, relatively high wages, and the high degree of skill involved in the production process. Because of this strong attachment and difficulty in attracting new workers, the workforce in this occupation has aged to the point where some employers have complained of severe problems in replacing retiring workers.

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[8] Occupational Outlook Handbook, p. 403.

Finally, despite a trend toward automation that has eliminated many manufacturing jobs, the impact of new technologies on the employment of tool and die workers is still uncertain. Over the past two decades, the machining of tools and dies has increasingly become reliant on NC and CNC equipment. Using electronic circuitry and controls, NC and CNC equipment permit the operator to program a series of machining operations that enable a lathe, mill, drill press, or other equipment to automatically machine a tool or part. Increasingly, tool and die workers have been required to supplement more traditional tooling methods with the use of NC and CNC equipment.

B. Training and Recruitment of Tool and Die Makers

This section discusses the educational requirements and qualifications for entry into the tool and die maker field, the factors affecting these requirements, and the methods employers use to fill vacancies in the field.

1. Educational Qualifications and Entry Requirements

General qualifications and entry requirements for tool and die makers are described in the Department of Labor's Occupational Outlook Handbook:

> Most employers prefer persons with a high school or vocational school education and mechanical ability. Prior to hiring, some employers test applicants to determine their mechanical aptitude and their mathematical ability. As a result, courses in

> shop math, blueprint reading, metal working, physics, and drafting, as well as machine shop experience, may be helpful.[7]

However, in our discussions with employers, we found considerable variation in the entry requirements and the extent to which these requirements were formally applied. Typically, larger firms with apprenticeship programs tended to have more formal entry requirements (i.e., as part of their requirements for entry into the apprenticeship program). Some smaller tool and die shops (of which there are many) appeared somewhat less strict in their requirements. The type and complexity of the machining work to be performed also contributed to the level of skills required.

In our interviews, we found that employers were generally looking for high school or vocational school graduates. Considerable emphasis was placed on basic educational skills -- particularly mathematics (including algebra, trigonometry, and geometry), science, reading comprehension, and problem-solving skills. Because of the relatively long training period for tool and die makers, employers were looking for candidates who had a "good attitude" and "conveyed an ability to learn." Employers also were looking for individuals with an "ability to use their hands" and a mechanical aptitude. Exhibit 6.1 displays some comments from our interviews with employers on general entry requirements and concerns about the available pool of candidates for tool and die maker positions and apprenticeship programs.

There is some disagreement over whether the entry requirements for tool and die makers have increased or decreased over the past decade. Some employers argue that the introduction of new technologies (particularly NC and CNC equipment) and increasing precision (e.g., often at one ten-thousandth of an inch in tolerances) has placed increasing

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[7] Occupational Outlook Handbook, p. 403.

Exhibit 6.1: Comments on General Entry Requirements and the Pool of Available Candidates for Positions from Firms Employing Tool and Die Makers

Ship Building Firm: Individuals entering the apprenticeship program at this large firm must have a high school diploma or equivalency, and pass a pre-employment physical and a review for security clearance. In selecting recruits for the apprenticeship program, the firm is particularly looking for a math/science background, including at least four high school credits for Algebra I and II, Trigonometry, and Geometry.

Tooling and Milling Equipment Manufacturer: This medium-sized manufacturer of tooling and machinery is looking for high school graduates who have solid basic education skills, particularly in mathematics. Because of a shortage in high school graduates with basic education skills (who want to enter manufacturing jobs), if the firm finds someone who conveys an ability to learn, it will often take the chance and hire them. However, many students who do not attend college are generally ill-prepared even to be trained as machinists.

Manufacturer of Heavy Machinery: The firm is looking for individuals who have the "capability" to be trained to become highly skilled machinists (e.g., tool and die makers). Individuals need basic skills -- math, reading comprehension, and problem-solving -- to be successfully trained to become skilled machinists. The firm has a rigorous selection process for both employment and entry into its apprenticeship program. Only about 50 percent of applicants to the apprenticeship program are accepted. The union (UAW) must approve candidates to the apprenticeship program.

Manufacturer of Diesel Engines: This firm recruits individuals for its toolmaker apprenticeship program only from those who are already working for them. The firm uses a test battery, which includes reading, math, writing, and some shop skills assessment. The selection process is fairly rigorous (e.g., 50 of about 200 applicants were selected two years ago and 45 out of 100 last year).

Tool and Die Shop: This small firm has no set qualifications or entry requirements, though it is looking for individuals who are good with their hands and can problem solve. The interviewee has found that one thing most of his highly-skilled machinists have had in common is an interest in "tinkering with car engines."

Aerospace Defense Contractor: The firm is primarily interested in individuals who have had some machining experience, usually persons in their late 20s or early 30s. Sometimes, however, the manufacturer will hire a young person who has recently completed a high school vocational program if their attitude seems good.

stress upon basic education skills (particularly mathematics and computer literacy). In addition, some employers note that work as a tool and die maker (and for highly-skilled machinists, in general) has become increasingly a "group" effort requiring stronger interpersonal and communication skills. For example, according to an owner-operator of one small tool and die shop, "more is being asked of new recruits now: they need to have math skills, be able to read blueprints, communicate, and work in groups."

Other employers acknowledge that while the work is becoming more complex and technologically based, firms have been forced to actually lower their recruiting standards because high school graduates (who do not plan to attend college) lack the basic skills and preparation that are needed to enter the field. This viewpoint is illustrated in the comment from an interview with an owner-operator of a medium-sized company that manufactures tooling and milling equipment: "In recent years, the entry requirements for tool and die makers have fallen to an all-time low because of a shortage of skilled machinists and the difficulty in locating new recruits who have the basic skills needed to enter the field."

Workers typically obtain the skills needed for entry into the tool and die profession through formal apprenticeship programs and/or on-the-job training. Apprenticeship programs, which involve four or five years of training, combine practical shop experience with classroom instruction. Apprentices learn to operate a variety of equipment, including milling machines, lathes, grinders, and other machine tools. They learn to use handtools in fitting and assembling tools, gauges, and other mechanical equipment. They also study heat treating and other metal working processes. Classroom training consists of shop mathematics, mechanical drawing, tool designing, tool programming, and blueprint reading. Several years of experience and on-the-job training after apprenticeship are often necessary to qualify for the most difficult tool and die work.[8]

Bell and Garvey[9] provide an overview of key characteristics of apprenticeship programs, which coincides with what we found in our interviews with employers sponsoring such programs:

- Apprenticeship programs are conducted or sponsored by employers. The employer identifies and defines the skills which are expected of a journeyman worker.
- The typical apprenticeship program has two major components: (1) on-the-job training, and (2) classroom instruction related to on-the-job training. In the metalworking industry, an apprenticeship program involves typically four years of on-the-job training, encompassing approximately 8,000 hours. While the apprentice is working on the job, he or she will normally take at least 144 hours of classroom instruction per year (e.g., two hours per night, twice a week, over a 36-week school year).
- The employer and apprentice employee enter into a formal written agreement which sets out the work processes which the apprentice will learn, the hours which will be worked and the wages the apprentice will be paid during the program. The employer agrees to provide employment and training, and the employee-apprentice agrees to learn the skills identified.
- At the end of the apprenticeship program, the graduating journeyperson receives a certificate of completion, similar to the diploma awarded by academic institutions. The certificates are issued by the Federal Bureau of Apprenticeship and Training or the state apprenticeship agency.

Exhibit 6.2 provides illustrations (from our interviews with employers) of the structure of apprenticeship programs and how they are used to prepare recruits for entry into the profession.

Workers who become tool and die makers without completing formal apprenticeships must acquire their skills through many years of on-the-job training. The

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[8] Occupational Outlook Handbook, p. 403.

[9] Bell and Garvey (1986).

Exhibit 6.2: Illustrations of Apprenticeship Programs in Selected Firms

Ship Building Firm: Most of this firm's workers receive the necessary skills for entry into the machine trades from its apprenticeship program. About 80 percent of the graduates of the apprenticeship program remain with the firm after five years. Over the four-year program, apprentices receive: (a) 8000 hours of on-the-job instruction; (b) 600 hours of academic instruction in areas such as shipbuilding, marine engineering, naval architecture, math and physics, drafting, communications, strength and materials, and metallurgy.

Because of the size of the program, a faculty of craft instructors and academic instructors is provided at the firm (e.g., students do not attend a local community college). When apprentices in the machine trades complete the four-year program, they are classified as 1st class journeymen machinists and move immediately into positions within the firm (although there is no obligation on the part of the firm to hire the graduates, they have always done so). These machinists are highly-skilled at this point, though with additional on-the-job training and instruction, they may later move to the level of 1st class specialist.

Tooling and Milling Equipment Manufacturer: Because of the scarcity of highly-skilled machinists, this firm provides most of the training that is needed to become a tool and die maker through on-the-job training and a recently initiated DOL-sponsored apprenticeship program. In order to attract new recruits, the firm initiated a DOL-certified apprenticeship program. The program is considered a "bell and whistle" by which the firm can attract new recruits -- with the exception of the DOL certification that individuals receive upon completion of the course, the firm had been providing much of the skills training and educational benefits that apprentices now receive. The difference -- and it appears to be important in recruiting -- is that each of the apprentices will receive a certification from DOL at the end of the program which says they have graduated from the apprenticeship program.

Each year the firm admits four recruits into the program. The program is four years in duration, involving: (a) 40-hour work week that involves intensive on-the-job training; and (b) three hours per week of course work (in drawing, mathematics, engineering, sciences) at a local community college. The company pays for the cost of the program, which is estimated at about $15,000 per year over a four-year period. Most of the costs to the firm are in lost production (the course work cost is just $150 per semester per student). The firm has six apprentices in the program. There have been no drop-outs in the first year of the program. However, with a limit of four new apprentices each year, the firm can only put 16 through the program over a four-year period -- which falls far short of its personnel needs in the future.

Manufacturer of Heavy Machinery: Because of the scarcity of highly-skilled machinists, this firm provides most of the training that is needed to become a tool and die maker or other type of skilled machinist (e.g., CNC operator) through its apprenticeship program. The firm's apprenticeship program offers about 8000 hours of instruction over a four-year period. It has an unusual relationship with a local community college, whereby the college provides instruction at the manufacturer's headquarters.

Precision Metal Jobbing Shop: This firm sponsors a four-year apprenticeship program, which is registered with DOL. Apprentices spend 4 1/2 days a week working for the firm receiving on-the-job training, then 1/2 day a week in classroom instruction at a local community college. The firm recruits high school graduates for this program, generally in the age range 18-21. Wages for the apprenticeship program gradually build up to 100 percent of journeyman wages as apprentices complete increments of the program (each 1000 hour increment, the wages are increased). The firm is currently re-vamping the program and is taking applications for two positions.

worker will usually start with straightforward machining jobs, on perhaps an engine lathe or drill press. Gradually, the worker will receive additional training in order to take on more difficult assignments. He or she also may receive some vocational school training in shop math, blueprint reading, and related subjects. Nearly all of the employers interviewed as part of this study provided considerable on-the-job training as part of their regular work environment.

2. Methods Employers Use to Recruit Tool and Die Makers

Employers use a variety of methods to recruit tool and die makers. Firms with apprenticeship programs (generally larger firms) attempt to fill most of their needs through these programs. Other firms (typically smaller firms, such as tool and die shops) recruit workers for lower-level machining and then gradually provide the on-the-job training that is necessary to guide workers to increasingly more sophisticated levels. Most employers and experts interviewed for this study asserted that it was difficult, if not impossible, to fill a vacant position by simply placing an advertisement in a local newspaper or with the employment service for an experienced tool and die maker. Several interviewees stressed that because of critical shortages of skilled machinists, they had become more creative in their recruiting methods in recent years. A number of employers we interviewed felt that their recruitment efforts needed to overcome an apparent bias (on the part of students, parents, and educators) against blue collar jobs. As will be discussed in greater detail later in this chapter, most employers felt that there was a great need for the machining industry to better inform educators (especially high school counselors and administrators), parents, and students of the challenging opportunities available in the machine trades (see Section E.2, Factors Contributing to Shortages).

Some of the methods used for recruitment of workers either to apprenticeship programs or directly into positions as tool and die makers are discussed below.

a. Newspaper Advertisements

Some firms use advertisements in local newspapers to recruit workers. Firms report relatively little success in recruiting tool and die makers, though they are sometimes successful in recruiting entry-level workers who may eventually be trained to become tool and die makers. For example, according to the owner-operator of one firm we interviewed: "When I run an ad, I get plenty of response from cooks, taxi drivers, and others that lack any sort of basic skills. What I need is someone that is capable of being trained. I get 50 responses to an ad, but few, if any, have the sort of basic skills that are needed to become a highly skilled machinist." This same owner indicated that at one point several years ago his firm was facing such a problem in recruiting skilled machinists. The firm advertised in local newspapers in other states (including Pennsylvania, Michigan, and Indiana) where large machine shops had closed down.

b. Job Listings with the Public Employment Service

Some firms list job openings with the Employment Service or other employment agencies. However, while this can be effective for lower-skill positions within the machining industry (production-type workers), firms appear to have relatively little success in recruiting workers that have the higher-level skills and experience that are needed to be tool and die makers.

c. Linkages with High Schools, Vocational Schools, and Community Colleges

Some firms have found that establishing close linkages with local schools can provide a valuable source of candidates for apprenticeship programs and for entry-level machinist positions. Ties with local schools range from informal contacts with machine shop instructors and counselors, especially when firms have vacancies, to establishment of formal programs with local school systems. For example, one large ship building firm that has an apprenticeship program for tool and die makers recently established an "adopt-a-school program." Under this initiative, instructors from the apprenticeship program are assigned to high schools, vocational and technical schools, and community colleges in the areas from which the program recruits. The instructors send literature and visit the schools on a monthly basis to talk with students and educators and provide other information services. Another firm we interviewed recently purchased a school bus, which it uses to bring high school counselors, teachers, and students to the plant so they can see for themselves the kinds of careers in which tool and die makers and other skilled machinists are involved. According to the owner of this firm, this is part of a general effort to overcome the bias that exists against manufacturing and blue-collar jobs among educators, parents, and students. The owner-operator of a small tool and die shop indicated that he regularly goes out to the schools to promote the machine trades (and manufacturing, in general) through sessions with students and teachers.

d. Word-of-Mouth

For many firms, particularly smaller firms that may only recruit as vacancies arise, word-of-mouth is viewed as perhaps the most reliable method of recruitment. Having employees, friends, and relatives "spread the word" about openings can often be the best means for identifying good prospects. One employer, for example, indicated that the firm had joined a variety of local and national tooling organizations in an effort to expand contacts and enhance recruitment efforts.

e. Other Methods

Because of the high degree of skill required of tool and die makers, a firm that has an apprenticeship program often will promote the program as an opportunity to learn a "career." As mentioned earlier, one firm indicated that it uses its recently initiated DOL-certified apprenticeship program as a "bell and whistle" to attract new recruits. Another firm indicated that it uses current apprentices and recent graduates of its apprenticeship program to disseminate information and assist in recruiting new candidates.

3. Methods Tool and Die Makers Use to Seek and Obtain Employment

There are a variety of methods that workers use to obtain employment within the tool and die occupation. The paths vary depending upon the background and training of the individual and the specifics of the local labor market. As discussed above, there are two major paths through which to enter the occupation: (a) enrolling in a formal apprenticeship program, generally operated by metalworking manufacturers, or (b) seeking employment as a machine operator (or other semi-skilled worker) for a metalworking manufacturer, then gradually acquiring the many skills that are necessary through a mixture of on-the-job training and classroom instruction. In either case, the worker typically must locate an employer who offers the formal or informal training that is necessary to develop the varied technical skills and experience that are needed within the profession. Several of the principal paths to employment within the machine trades are discussed below.

a. High School Counseling and Placement Activities

Most vocational and technical high schools maintain a more or less formalized employment service for their students. Often business and labor leaders serve on advisory boards of the schools to assist them in defining the curricula and securing equipment for the schools' machine shops. These business and labor leaders also provide invaluable contacts with local employers for placing students in apprenticeship programs and jobs within the machine trades. In our interviews, employers indicated that they have become increasingly involved with local schools, both to ensure that their training needs are being met and to identify and recruit qualified candidates for employment. As a result of these linkages, teachers and advisors play key roles in disseminating information to students about apprenticeship programs and job opportunities as tool and die makers.

b. Registration with Public and Private Employment Service Agencies

Local offices of the Employment Service provide information about job openings within the metalworking industry. In our interviews, employers indicated that they often list jobs with local Employment Service agencies, but that by and large the workers who are referred through these agencies lack the basic skills necessary to become tool and die makers. There are also private employment agencies that maintain listings of openings in the machine trades.

c. Other Methods

In addition to the methods referred to above, workers might find out about potential job openings or training slots by (a) consulting want ads in local newspapers, (b) using union hiring halls, (c) contacting trade associations and their local chapters (e.g., National Tooling and Machining Association), and (d) word-of-mouth referrals from relatives, friends, or other acquaintances.

C. Employment and Earnings in the Tool and Die Maker Occupation

This section describes and analyzes trends in the employment and earnings of tool and die makers in the United States. These trends provide insight into the size and history of the labor market for tool and die makers, as well as preliminary indications of whether potential shortages of tool and die makers exist.

1. Employment Trends

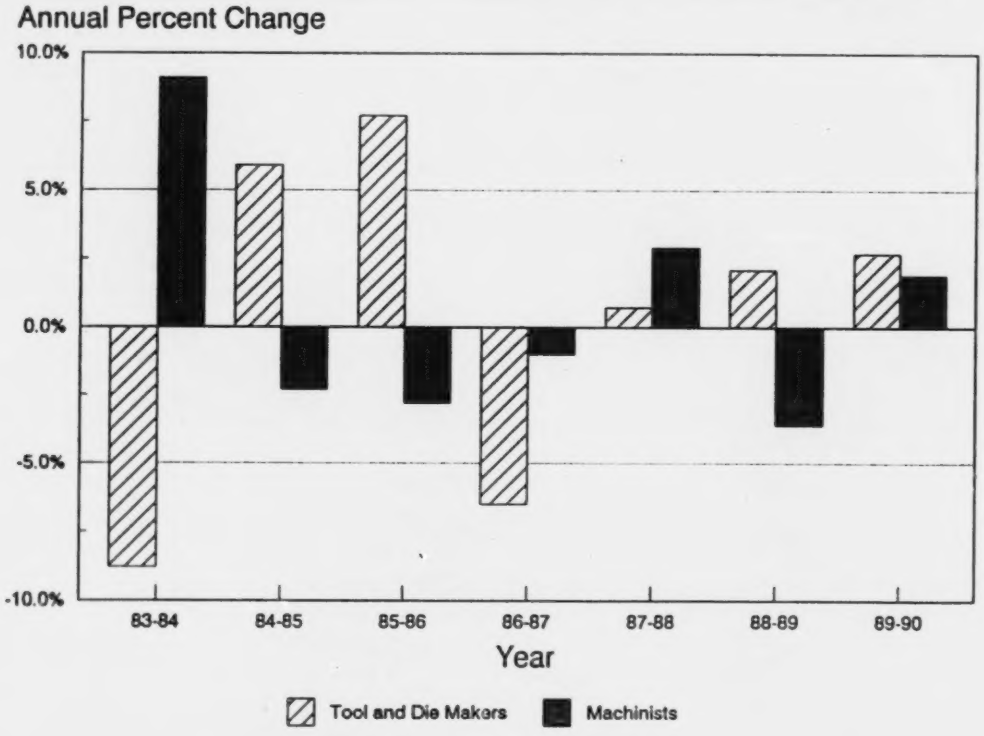
a. Overall Employment Levels

Changes in the level of employment within an occupation often reflect trends in demand for workers within the field. An increase in employment suggests an increase in demand, while a decrease suggests a decline in demand. A labor shortage is typically more likely to occur if demand is increasing than if it remains constant or declines because the supply of workers may not be adequate to meet the growing demand.

Exhibit 6.3 shows that employment levels for tool and die makers have been relatively stable over the past eight years. In fact, the number of tool and die makers employed in 1990 -- 152,000 workers -- was only slightly above the number employed in 1983 (148,000). As shown in this exhibit, there have been only relatively modest changes in the number of tool and die workers during this period, ranging from 143,000 in 1984 to 154,000 in 1986. This exhibit also compares the average annual percentage change in employment for tool and die makers with machinists. Between 1983 and 1990, there was only slight growth in the number of workers employed within either occupation -- averaging 0.5 percent per year for tool and die makers and 0.6 percent for machinists. Overall, the relatively slow growth in employment levels within the tool and die maker occupation over such a lengthy period is an indication of sluggish demand. Unless there

Exhibit 6.3: Employment of Tool and Die Makers and Machinists, 1983-1990

	Employment		*Percent Change*	
	Tool and Die Makers	Machinists	Tool and Die Makers	Machinists
1983	148,000	471,000		
1984	135,000	514,000	-8.8%	9.1%
1985	143,000	502,000	5.9%	-2.3%
1986	154,000	488,000	7.7%	-2.8%
1987	144,000	483,000	-6.5%	-1.0%
1988	145,000	497,000	0.7%	2.9%
1989	148,000	479,000	2.1%	-3.6%
1990	152,000	488,000	2.7%	1.9%
Average			0.4%	0.5%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

were constraints on supply -- perhaps caused by shrinkage in the pool of candidates to select from or by retirement of existing workers -- slack demand within the occupation would normally signal that shortages are not a major problem.

b. Average Annual Unemployment Rates

In the absence of vacancy rate data, perhaps the most direct measure of a labor shortage that is currently available is the occupational unemployment rate.[10] Occupations experiencing shortages, in which the number of vacancies is greater than the number of qualified applicants, are likely to have very low unemployment rates -- since those searching for jobs find them quickly, and are thus unemployed for a very short period. Exhibit 6.4 illustrates the unemployment rate for tool and die workers; machinists; precision production, craft, and repair workers; and all workers. The annual unemployment rate for tool and die makers was very low between 1983 and 1990 -- averaging 2.9 percent. The comparable rate for machinists during this period was over double that for tool and die makers -- 6.1 percent. The average unemployment rate for all precision production, craft, and repair workers was 6.9 percent and for all full-time salary and wage workers over the age of 16 was 6.7 percent.

The relatively low rates of unemployment for tool and die makers appear to be related to several factors. According to the Occupational Outlook Handbook, the relative stability (even in recessionary periods) is related to the difficulty that employers have in

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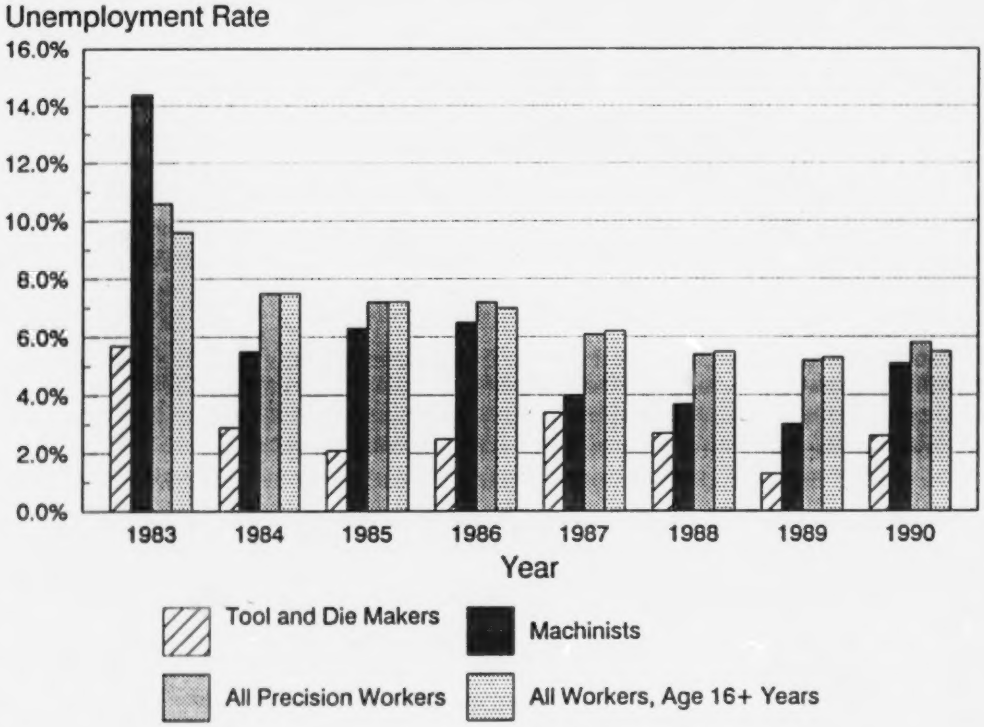
[10] These data are derived from the Current Population Survey. Unemployment rates are computed by aggregating total unemployment within an occupational classification and dividing by the total labor force in that classification. The unemployment rate is low either when demand exceeds supply, or when the two are in balance. In general, according to Cohen, a low unemployment rate suggests the possibility of a labor shortage within an occupation. See: Malcolm S. Cohen (1990). Study on the Feasibility of Using Labor Market Information for Alien Certification Determination. Ann Arbor, Michigan: Institute of Labor and Industrial Relations, University of Michigan.

Exhibit 6.4: Unemployment Rate for Tool and Die Makers, Machinists, Precision Production, Craft, and Repair Workers, and All Workers Over Age 16

	Tool and Die Makers	Machinists	Precision Workers	All Workers
1983	5.7%	14.4%	10.6%	9.6%
1984	2.9%	5.5%	7.5%	7.5%
1985	2.1%	6.3%	7.2%	7.2%
1986	2.5%	6.5%	7.2%	7.0%
1987	3.4%	4.0%	6.1%	6.2%
1988	2.7%	3.7%	5.4%	5.5%
1989	1.3%	3.0%	5.2%	5.3%
1990	2.6%	5.1%	5.8%	5.5%
Average	2.9%	6.1%	6.9%	6.7%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

replacing tool and die makers:

> ...Employment of tool and die makers is less sensitive to fluctuations in the business cycle than many other production occupations. Because these workers are highly-skilled and not easily replaced, employers are reluctant to lay them off even when production is cut back.[11]

Employers we interviewed were clearly reluctant to lay off experienced tool and die makers because of costly investments they had made in training their workforce through on-the-job training and formal apprenticeships and concern over an inability to hire other workers with the specific blend of machining skills needed. For example, an owner-operator of a small tool and die shop stated: "I would have skilled machinists paint the factory floor before I'd let them go ... I try to keep them as happy as I can." For their part, tool and die makers typically choose to be with one employer for relatively long periods.

Other things being equal, most analysts would consider the relatively low unemployment rate for tool and die makers (especially when it reached 1.3 percent in 1989) as an indicator of a relatively tight labor market. For example, of the 193 occupations that Cohen examined in 1989, only 38 had an unemployment rate under 1.6 percent. While the relatively low unemployment rate for tool and die makers is an indication of "tightness" or potential shortage, it is not proof that a shortage exists.

2. Earnings Trends

As discussed in Chapter 2, the rate at which wages change within an occupation is often viewed as an important indicator of labor market dynamics, especially in the short run. In occupations where markets move freely (i.e., supply, demand, and wages are not regulated by the government), a rapid rise in wages may indicate the presence of a shortage. Exhibit 6.5 shows median weekly earnings in the United States for tool and die makers from 1983 to 1990, in comparison with (a) machinists, (b) precision production, craft, and repair workers, and (c) all full-time salary and wage workers over the age of 16. This exhibit demonstrates that earnings for tool and die makers have been substantially higher than the average for all workers. For example, in 1990 the median weekly earnings for a tool and die maker was $557, compared to $415 for the U.S. labor force. In fact, one recent study by the Bureau of Labor Statistics of 26 skilled occupations found that tool and die makers ranked seventh in net lifetime earnings, behind dentists, physicians and surgeons, several types of engineers, and owners and managers in finance, insurance, and real estate.

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[11] Occupational Outlook Handbook, p. 403.

In 1988, according to the Bureau of Labor Statistics, most tool and die makers earned between $433 and $680 per week. Ten percent earned less than $335 a week, while the upper 10 percent made more than $818. Tool and die makers employed in metropolitan areas had average earnings of $15.35 per hour. In comparison, the average for all non-supervisory workers in private industry, except farming, was $9.29. In addition to their hourly wages, tool and die makers usually enjoy a variety of benefits, including health and life insurance, vacation and sick leave, and retirement plans.[12]

While the median weekly and lifetime earnings of tool and die makers were relatively high compared to other manufacturing occupations, the rate of change in earnings is a more reliable indicator of whether shortages exist within an occupation. Economic theory suggests that within freely moving labor markets greater changes (relative to other occupations) in earnings within a profession may indicate the presence of a shortage of workers. As Exhibit 6.6 shows, median weekly earnings for tool and die

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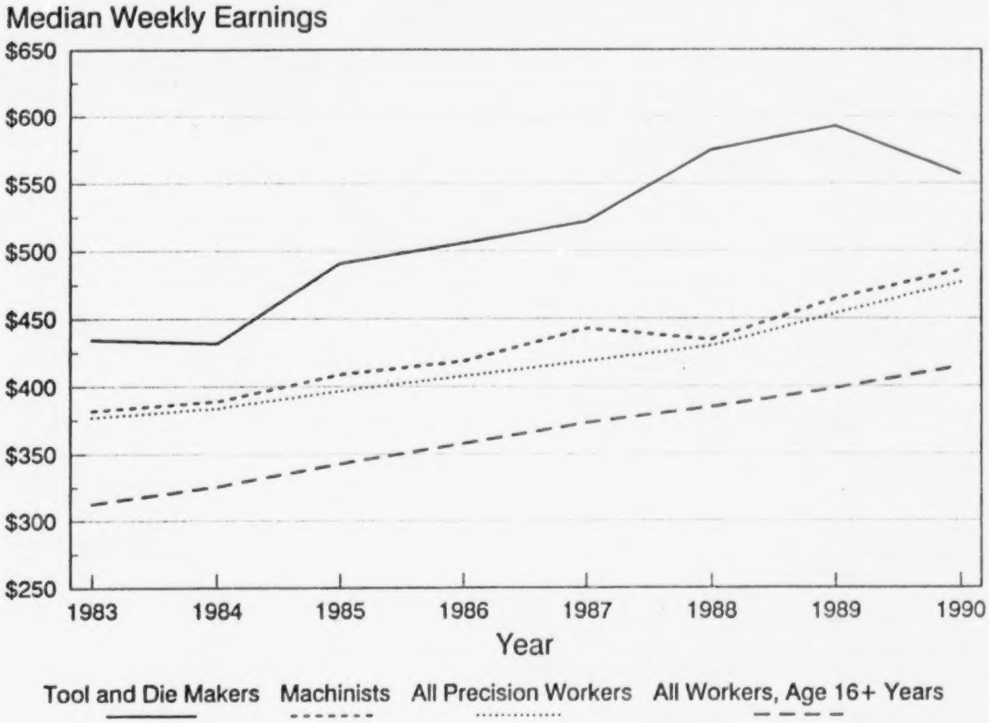
[12] Occupational Outlook Handbook, p. 403.

Exhibit 6.5: Median Weekly Earnings for Tool and Die Makers, Machinists, Precision Production, Craft, and Repair Workers, and All Workers Over Age 16

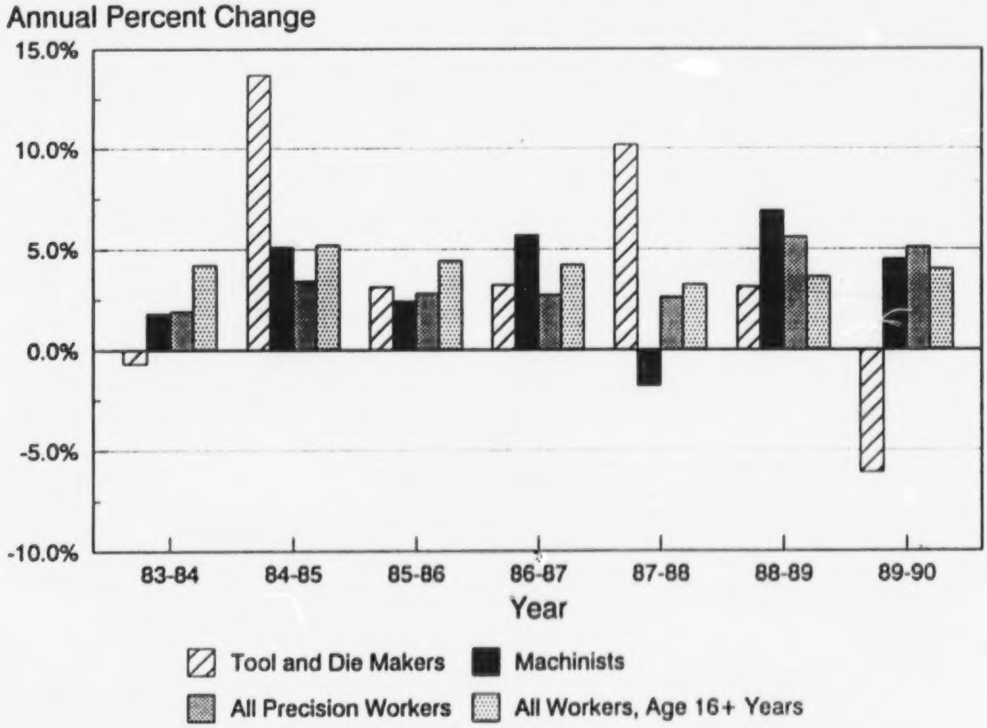
	Tool and Die Makers	Machinists	Precision Workers	All Workers
1983	$435	$382	$377	$313
1984	432	389	384	326
1985	491	409	397	343
1986	506	419	408	358
1987	522	443	419	373
1988	575	435	430	385
1989	593	465	454	399
1990	557	486	477	415



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

Exhibit 6.6: Percent Change in Median Weekly Earnings for Tool and Die Makers

	Tool and Die Makers	Machinists	Precision Workers	All Workers
83-84	-0.7%	1.8%	1.9%	4.2%
84-85	13.7%	5.1%	3.4%	5.2%
85-86	3.1%	2.4%	2.8%	4.4%
86-87	3.2%	5.7%	2.7%	4.2%
87-88	10.2%	-1.8%	2.6%	3.2%
88-89	3.1%	6.9%	5.6%	3.6%
89-90	-6.1%	4.5%	5.1%	4.0%
Average	3.6%	3.5%	3.4%	4.1%



Source: Cohen, Malcolm. Unpublished tabulations of the Current Population Survey, various years. Also, U.S. Department of Labor, Bureau of Labor Statistics. Handbook of Labor Statistics. Bulletin 2340. August 1989.

makers increased by 3.6 percent on an average annual basis between 1983 and 1990. This average rate of increase was about the same as that for machinists (3.5 percent) and precision production, craft, and repair workers (3.4 percent), but slightly below that for all U.S. workers (4.1 percent).

Finally, there is considerable variation in average hourly earnings for tool and die makers in selected geographic areas across the United States. For example, according to the Bureau of Labor Statistics, average hourly earnings in selected geographical areas in 1988 were as follows:

San Jose	$17.63
Detroit	$16.30
St. Louis	$16.04
Boston	$15.44
Atlanta	$15.24
Cleveland	$14.93
New York	$13.51
Houston	$12.89
Scranton-Wilkes Barre	$12.50

This variation in earnings may reflect shortages of tool and die makers within specific labor markets. Alternatively, it may reflect regional differences in the cost-of-living, union contract negotiations, or the extent of competition by local employers for skilled manpower.

D. Factors Contributing to a Labor Shortage

1. Presence of a Shortage

Our assessment of the labor market conditions for tool and die makers neither confirms nor rejects the notion of the presence of a shortage for this type of worker. Rather, it provides conflicting evidence -- both quantitative and qualitative -- that suggests the possible existence of supply-side constraints that may result in "tightness" or even shortages in some local labor markets. Further, the nature of the supply-side constraints -- particularly the lack of qualified younger workers to replace a highly-skilled, aging workforce -- may signal increasing shortages of tool and die makers in the coming years.

The aggregate patterns of employment and earnings (discussed in the preceding section) provide conflicting evidence as to whether shortages exist (or will exist in the near future) within the tool and die making occupation. Two aggregate trends point to potential shortages for tool and die makers:

- a consistently low rate of unemployment; and
- relatively high earnings and higher than average growth in median weekly earnings.

However, other aggregate data (particularly those reflecting demand-side factors) suggest relatively less likelihood of shortages:

- virtually no employment growth in recent years;
- sluggish growth in projected demand for tool and die makers through the year 2000 (discussed below); and
- low replacement demand (discussed below).

In our interviews, we found a considerable range of opinion about whether shortages did in fact exist. Some employers indicated that they faced "severe shortages" that constrained their ability to expand their businesses and, at times, to even meet existing demand for their products. Others suggested that while they did not face current shortages, they had periodically experienced shortages of tool and die makers in the past and expected to face shortages in the future. Even those who did not view shortages as a problem for their firms felt that most employers faced a relatively "tight" and shrinking pool of qualified candidates from which to draw skilled manufacturing workers. There appeared to be a general consensus that "supply-side" constraints were the principal causes of such shortages.

The evidence of shortages provided by employers is, of course, anecdotal, particularly citing (a) a serious shortage of skilled machinists who can move directly into positions (without training), and (b) a shrinking pool of young, unskilled workers who have the basic education and skills that are necessary to master the variety of machining skills that a tool and die maker must possess. To further exacerbate this problem, employers point to a generally "aging" group of existing tool and die makers who will need to be replaced during the next decade. Several illustrations of the varying views of employers regarding shortages of tool and die makers are shown in Exhibit 6.7.

2. Demand-Side Factors

Labor market analysts and employers generally point to few demand-side factors resulting in the present or future likelihood of shortages. Looking back over past trends in employment and forecasts for growth through the year 2000, there is little to suggest that demand-side factors have or are likely to exacerbate shortages for tool and die makers.

a. Projected Employment Growth from 1988 to 2000

The outlook for tool and die makers appears to be one of relatively slow growth. The Bureau of Labor Statistics has projected an annual rate of employment growth of 0.4 percent for the tool and die occupation compared to 1.2 percent for the United States as a whole.[13] This rate of change in the demand for workers is slightly below that of machinists (0.7 percent), the same as that of sheet metal workers, and well above that for other precision product occupations (-1.4 percent) and metal working and plastic working

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[13] This rate of increase is for 193 occupations examined by Cohen (1990).

Exhibit 6.7: Illustrations of Comments from Interviews on the Extent of Shortages of Tool and Die Makers

Firms Experiencing Shortages

Tooling and Milling Equipment Manufacturer: This firm is, and has been for many years, facing what the interviewee termed "a critical shortage" of skilled machinists. Shortages for skilled machinists have become "significantly worse" over the past 10-15 years to the point where they threaten the continued existence of the manufacturing division of this firm. The firm "always has openings" for highly-skilled machinists and has experienced no lay-offs over the past five years. In response to such shortages the firm has run advertisements in local newspapers. While the ads have resulted in many inquiries, very few job candidates have had the basic skills (particularly mathematics) to allow them to be trained as skilled machinists. The firm has not had a skilled machinist walk in off the street looking for employment in years.

Precision Metal Jobbing Shop: When this firm has attempted to hire workers for vacant positions as tool and die makers, it has found a serious lack of skills in the general population. According to the president of the firm, "It is not that there are too few bodies...but there is a general lack of basic education and skills that are needed to become precision metal workers." This firm currently has two positions open for tool and die makers -- one the firm has been trying to fill for 6-8 months; the other for about a month. Generally, the difficulty in hiring for this firm depends upon the level of worker needed. At the highest skill level (i.e., tool and die maker, highly-skilled precision metal worker), there are continuous openings. At the next level (CNC operator), there are usually openings. At the lower-skilled and unskilled levels, there are spotty and often infrequent openings. According to the firm's president, "Over the past 20 years, there has been almost a continuous human resource problem within the skilled machinist occupation...all firms seem to have the same problem...finding and keeping skilled workers."

Tool and Die Shop: This firm, like many other smaller job shops, has been unable to attract tool and die makers. The firm has constantly had a couple of openings for these highly-skilled workers over the past two or three years. No highly-skilled machinists have been laid off in recent years.

Firms Not Facing Shortages

Ship Building Firm: Because of the success of its apprenticeship program, the firm has not experienced problems in filling positions for tool and die makers. Most of those graduating from the apprenticeship program simply go to work for the firm. However, the firm has experienced a substantial reduction in the pool of candidates for its apprenticeship program in recent years. For example, in the early 1980s, there was a 8 or 9 to 1 ratio of applicants to those actually selected; this number is now down to 3 or 4 to 1.

Manufacturer of Heavy Machinery: This firm has not faced a shortage of tool and die makers in recent years, but faces a relatively tight market. In fact, this firm laid off some of its highly-skilled machinists several years ago because of financial problems. Since then, it has been able to rehire some of those workers to fill vacancies. In general, the firm has been able to hire very few tool and die makers "off the street" -- either they are trained by the firm through its apprenticeship program or the firm rehires highly-skilled machinists laid off several years ago.

Manufacturer of Diesel Engines: In recent years, this firm has been able to meet its need for tool and die makers through its apprenticeship program or rehiring workers it laid off several years ago. However, the interviewee indicated that many smaller firms and those without apprenticeship programs face critical shortages of highly-skilled machinists. Further, these shortages (especially for smaller firms) are a national problem -- in meetings with other employers, they often "talk about the problems of finding people" with the appropriate level of skills.

Aerospace Defense Contractor: Because of the slowdown in the economy and the introduction of NC and CNC equipment, this firm's need for tool and die makers has diminished in recent years. For example, NC and CNC equipment has virtually eliminated the need for tool and die makers in the casting of dies for sheet metal punches. The interviewee felt that while this firm did not have a current problem with shortages, smaller shops faced real problems in getting qualified machinists. Some of the smaller shops in the area have complained that there is a lack of solid vocational programs.

machine operators (-0.4 percent). According to the Occupational Outlook Handbook:

> Employment of tool and die makers is expected to increase more slowly than the average for all occupations through the year 2000. As the economy grows, the demand for motor vehicles, aircraft, machinery, and other products that use machined metal parts will increase. Rising demand for these goods will increase the need for tools and dies and the workers who make them.[14]

Despite the relatively slow projected employment growth through the end of the century, there are a number of underlying factors that create uncertainty about future demand for tool and die makers. First, there is considerable uncertainty concerning the potential long-term effects on employment within this occupation from increasing use of NC and CNC equipment. The Occupational Outlook Handbook suggests that such expansion will probably reduce the demand for tool and die makers:

> Employment growth, however, will be limited by increased use of numerically-controlled machine tools and imports of machined products. The greater use of NC machine tools has reduced the number of operations done by hand. Producers obtain high quality precision parts with fewer workers.[15]

Other analysts suggest that the expanded use of NC and CNC equipment, while substantially changing the way in which tool and die makers operate, will create new opportunities and perhaps expanded demand for skilled machinists:

> ...More and more of these automated devices and machines will be used in the future, but they will not replace the skilled machinist. Skilled machinists will be needed to build and maintain these systems... In short, while new technology will surely bring many more changes in manufacturing processes, the skilled person will always be needed. Skilled toolmakers, diemakers, moldmakers, and machinists are often called the high priests of mass production technology. They will continue to be at the leading edge of new production developments. Tremendous opportunities abound in the skilled metal working trades for those aggressive individuals who are willing to learn new techniques and skills.[16]

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[14] Occupational Outlook Handbook, p. 403.

[15] Occupational Outlook Handbook, p. 403.

[16] Bell and Garvey (1986), p. 57.

Second, economic conditions within the country will play an important role in determining the growth in employment within the tool and die occupation. Because the tool and die industry provides the tools, dies, and molds that are used in mass production (by other firms) of consumer goods (e.g., automobiles), employment within the field will be substantially affected by general economic conditions. If the economic slowdown of 1990-91 should continue and even deepen, employment growth within the tool and die occupation could be even slower than that projected by the BLS. Finally, employment within the tool and die occupation is also dependent upon the extent of imports and exports of both machine tools and finished products. For example, according to the Occupational Outlook Handbook:

> ... Because precision metal products are a primary component of manufacturing machinery, increased imports of finished goods, as well as precision metal products, affect employment demand for tool and die makers.[17]

Given likely fluctuations in currency rates, current negotiations over barriers to international trade (e.g., the Free Trade Agreement with Mexico and Canada), and uncertain international economic conditions, there is considerable uncertainty about how the level of imports and exports of both machine tools and finished products will affect employment within the tool and die occupation in the coming years.

b. Replacement Demand

In any given year, workers leave an occupation for a variety of reasons -- illness, death, retirement, or to enter new professions. High rates of turnover -- i.e., the need to replace workers -- within an occupation may signal (though certainly not prove) the existence of potential shortages. There is considerable concern within the machine tool industry over the relatively high proportion of tool and die makers over the age of 50.

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[17] Occupational Outlook Handbook, p. 403.

Given the relatively long training period, there are some fears that as these older workers leave the occupation, employers will be unable to find workers with the appropriate skills and experience to fill vacancies (i.e., not enough trainees in the pipeline).

In recent years, the replacement demand[18] for tool and die makers (8.7 percent in 1986-87) has been relatively low compared to most other occupations in the United States. For example, among the 193 occupations analyzed by Cohen (in 1986-87), the replacement demand for tool and die workers was in the lowest quartile. Further, the replacement demand for tool and die makers was also low compared to other related professions: it was slightly below that for machinists (9.1 percent) and sheet metal workers (10.7 percent), and well below that of other precision production occupations (13.9 percent) and metalworking and plastic working machine operators (17.2 percent).

The relatively low rate of replacement demand for tool and die makers most likely reflects the strong attachment that tool and die makers generally have to their jobs. This strong job attachment -- in which workers often stay with the same employer for 20 or 30 years -- appears to be a result of several factors, including: (a) long and costly investments in training by workers, (b) relatively high wages and lifetime earnings (compared to other manufacturing jobs), and (c) rigorous efforts on the part of employers to hold on to a skilled workforce in which they have made substantial (human capital) investments. While the low rates of replacement demand appear to suggest a lower than average probability of generalized shortages within the tool and die occupation, the general "aging" of the tool and die workforce in the United States suggests that the replacement demand for this type of worker may increase substantially during the 1990s. This possibility, coupled with the relatively long training periods and a shrinking pool of young, qualified workers willing to enter the tool and die making profession, may signal growing shortages in the future (at least in some local labor markets).

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[18] Although BLS does not currently publish estimates of replacement demand by occupation, Cohen was able to estimate replacement demand by using unpublished data provided by BLS. To obtain a measure of replacement demand, Cohen counted all workers who left an occupation, and then expressed the rate as a percentage of workers employed in the occupation in 1986.

3. Supply-side Factors

Employers who indicate they face shortages of tool and die makers identified several supply-side factors that restrict the flow of new workers into the profession. The major problem identified by employers is that they are finding it increasingly difficult to replace retiring workers with younger workers. For example, one employer (a manufacturer of tooling and milling equipment) complained that over the past decade many of the tool and die workers who had been with the firm for 30 to 40 years have retired and it has been virtually impossible to find experienced workers to replace them: "I can't find a highly-skilled machinist...haven't found one in three years..." Given this apparent lack of experienced tool and die makers, firms are typically forced to recruit young, unskilled workers and provide apprenticeship training and more informal on-the-job training. According to employers and other labor market experts, several factors contribute to an inadequate supply of younger workers who can be trained to become tool and die makers. These factors are discussed below.

a. Lack of Prestige -- "Blue Collar" Bias

Many of those interviewed felt that a strong "blue collar" bias has affected the willingness of younger workers to consider entering occupations within the manufacturing sector. High school graduates who have mastered the basic skills necessary for entry into the skilled machinist field have been, by and large, encouraged by educators and parents alike to prepare for more prestigious and well-paying occupations. This perspective was echoed by a number employers that we interviewed:

> ...High school counselors are in 'never-never land.' They are unaware of the well-paying opportunities within the machine trades. Parents are also a big obstacle -- they definitely have a bias against their children entering the machine trades.
>
> ...The machine trades have not been promoted in our schools and are not a glorified field. It's a tough society in which to sell a job in the machine trades. Every parent wants their kids to attend college and then get a M.B.A. or Ph.D.
>
> ...One of the major barriers that our firm's apprenticeship program has had to overcome in recruiting young workers has been an apparent bias against careers in the manufacturing sector. Part of this problem stems from the fact that high school principals and counselors are evaluated in terms of the percentage of graduates that go on to college. This reinforces a bias against students entering manufacturing occupations. Manufacturing jobs, like those of tool and die makers, are not given the same recognition as jobs requiring a college education within the service sector.
>
> ...Image has been a major factor that has contributed to the inadequate supply of skilled machinists. Everyone wants to attend college.

b. Lack of Knowledge About Opportunities within the Machine Trades

Many interviewees felt that high school students are not provided with adequate information about employment and training opportunities within the machine trades. Interviewees felt that the machine trades industry has failed "to get out its message" about the many well-paying and challenging opportunities for skilled machinists. They also feel that educators and parents generally lack knowledge of the machine trades and/or are reluctant to provide information to students that would encourage them to enter the trades. Several comments from employers we interviewed illustrate this viewpoint:

> ...The bias against entry into blue collar professions is further exacerbated by the fact that educators, parents, and high school students are unaware of the well-paying opportunities within the machinist field and manufacturing in general. High school teachers and counselors are simply not equipped to counsel students about opportunities within manufacturing.
>
> ...There is a serious problem with high school counselors who are unaware of the many well-paying opportunities within vocational trades and push students toward college. Industry and education have not established satisfactory linkages.

> ..The machine trades is not telling its story very well. There is a lack of activism on the part of industry. We have not encouraged schools to prepare students for jobs in industry and people are generally misinformed about the role of manufacturing in the economy. Public awareness is a lot of the problem.

c. Poor Basic Skills

As a prerequisite for being trained as a tool and die maker, an individual needs a solid foundation of basic education and skills, particularly in mathematics and science. Employers complain that while basic education skills were the standard 20 years ago (e.g., nearly all entrants to the field had at least some training in solid geometry, algebra, trigonometry), many of those seeking to enter the machine trades today are seriously lacking in the required basic skills. Without such skills, employers find that it is difficult, if not impossible, to provide workers with the training needed to plan and execute complex machining projects and to effectively operate a variety of machining equipment. In addition, employers are often reluctant to take the time and absorb the costs of providing recruits with basic education training (i.e., generalized training), before providing more specialized training as a tool and die maker. In general, employers feel students who are not planning to attend college are not being adequately prepared by high schools to directly enter other vocations. Some examples from our interviews of this perspective follow:

> ...The quality of new entrants has really fallen over the last 10 to 15 years. New entrants need basic education -- especially basic mathematics background (algebra, solid geometry, trigonometry) -- but the candidates that are coming to the field lack these basic skills. Basic skills that were the standard 20 years ago are woefully lacking now. Part of the problem is that high school kids who have basic skills are all going off to college and those that are left have very little in the way of skills.

> ...As technology has advanced within the machining trades, entry level requirements have changed -- skilled machinists can no longer be trained on the job if they lack appropriate basic skills.

> ...High schools are geared for college preparation. There is really very little meaningful vocational education. Vocational classes are unfortunately viewed as

> an easy way through high school. Students who do not attend college often have the aptitude for a job like a tool and die maker but lack confidence and self-esteem. In fact, the educational system is doing a disservice because students are left with a feeling of low self-esteem if they do not attend college. For most students vocational education is not a reality, it is just a way to get through school and avoid most classes. This is a national problem.
>
> ...The real problem is with the students who neither plan to attend college nor have developmental disabilities: upon graduation, these students do not have the skills to do much of anything.
>
> ...The work for skilled machinists is more technical and complicated than before -- requiring greater skills and precision. Those who come to our apprenticeship program are often lacking in the basic skills that are needed to become skilled machinists.

d. Relatively Long Training/Apprenticeship Period

Some employers indicate that the relatively long training period for skilled machinists may be a factor in the willingness of younger workers to enter the tool and die trade. For example, one firm that produces milling machinery, claims it took new recruits 10 to 12 years to become fully trained for some of the highest precision work. While none of the firms interviewed that have apprenticeship programs complain of problems with recruitment for their programs, a long training period can reduce the size of the applicant pool, result in higher levels of attrition during the training period, and reduce the ability of employers to respond to short-term shortages. In addition, the length and costs of apprenticeship programs reduce the willingness of small- and medium-size firms to sponsor such programs.

e. Lack of Training Facilities in High Schools

A number of interviewees complain that area high schools have eliminated machine shop and vocational programs. In general, such programs have been eliminated because of cutbacks in expenditures by local school districts -- it is relatively expensive to run such programs -- and a lack of interest on the part of students. Interviewees also blame the educational system as a whole, which creates incentives for high school principals and counselors to prepare students for and place them in universities and colleges. Some examples of this perspective from our interviews follow:

> ...Over the past 15 years, there has been a loss of 19 vocational machine shop programs in the four counties that surround our factory. In 1975, there were 23 vocational machine shop programs, now there are only four. It appears to be a vicious cycle: students are not aware of opportunities and are biased against a career as a machinist, so they do not select the coursework; the costs of running a machine shop are relatively high, so when there is little demand for the coursework, schools cut back or eliminate the facilities.
>
> ...Not a single high school within 10 miles of the firm has shop class available for students. Where 10 years ago all of the high schools had such facilities, they no longer do. As a consequence, students are not introduced to shop.
>
> ...School districts are increasingly closing down vocational programs. Recently, three more high schools in the state closed down their machine shops (turning them into maintenance shops for the school) as cost cutting measures. In addition, those schools that retain their vocational programs generally lack state-of-the-art equipment.

f. Other Factors

A number of other factors may also contribute to the tightness in the market for tool and die makers:

- **"Baby bust":** The "baby bust" has reduced the applicant pool for apprenticeship programs and entry-level positions.
- **Apprenticeship Wages:** While the earnings of tool and die makers are relatively high compared to other manufacturing workers, apprentices receive a training wage that is a percentage of what is paid to experienced tool and die makers. With the apprenticeship period for tool and die makers quite long, some prospective workers may be discouraged by such a lengthy period of relatively low earnings.
- **Traditionally Male Workforce:** Until recently, the machine trades have been viewed almost exclusively as an occupation for men. While this is changing -- especially with increasing emphasis on use of CNC equipment -- the number of women interested and willing to work as tool and die makers is still quite restricted.

E. Adjustments to Shortages by Employers

As discussed in Chapter 2, there are a range of strategies that employers can use to adjust to or alleviate the effects of shortages of labor. Some of the adjustments that employers of tool and die makers have used in the past or are planned should future shortages emerge are examined below. Potential government and educational responses to future shortages are discussed in the final section of this chapter (under recommendations).

1. Intensify Recruitment Efforts

Several firms indicated that they have become more intensive and "creative" with their recruitment efforts in recent years. Some firms have intensified recruitment through established channels -- such as increasing advertisements in local newspapers or intensifying efforts within public and private employment agencies. However, some firms indicated that increasing efforts through established channels has relatively little effect on the ability to fill vacancies. Such efforts generally result in an increase in the number of job applications, but generate few workers with the basic education and skills needed to become highly-skilled machinists.

Several firms stressed the importance of being more creative in their approach to recruitment. They emphasized the importance of establishing linkages with local high schools and technical schools to promote careers within the machine trades and to identify potential candidates for employment. For example, an owner-operator of a small tool and die shop we interviewed indicated that he regularly goes to local high schools to discuss opportunities within the machine trades with teachers and students. According to this owner-operator: "Firms need to go into the schools and let their needs be known and to educate guidance counselors, teachers, and students about the many opportunities that are available within the machine trades." In his discussions, he tries to emphasize that students need to be "realistic" about their futures. This owner-operator stresses that even if a student plans to attend college, it is possible to start with a career in metal working. Such a career is likely to provide educational benefits and resources that can help to pay for college. Employers emphasize the importance of overcoming biases against the machine trades (and other manufacturing jobs) by talking directly with educators and students about the many high-paying jobs within the field, the potential for continuing education and advancement, and the changing nature of the machining trades with the advent of NC and CNC equipment.

2. Use of Overtime

Overtime work is common within the machine trades. Most firms we interviewed indicate that they use overtime as one method to get around shortages of tool and die makers and to meet delivery dates for products. For example, in one firm, tool and die makers typically work 56 hours per week; another firm indicates that tool and die makers generally get about 10 percent in overtime work above their 40 hours per week. For the firm, the advantage of overtime is that fringe benefit costs are largely fixed and worker hours can be varied on a weekly basis in accordance with the demand for services.

3. Reduce Minimum Qualifications for the Job

Some firms indicated that there has been a de facto lowering of minimum hiring requirements because of an inability to find younger workers to replace retiring machinists. For example, according to one employer we interviewed:

> ...Over the past 10 to 15 years, we have lowered our standards for hiring younger workers to become machinists. This is because we have experienced such difficulties in finding qualified individuals. Where strong mathematic skills and basic education were formerly a requirement, we will take a chance with someone that we believe we can successfully train.

However, there is not a consensus on the issue of reduction in minimum hiring requirements -- several of those interviewed suggest that because the work is increasingly computerized, hiring requirements have actually increased over the years.

4. Restructure Work to Use Current or New Employees in Other Occupations

Several of those interviewed indicated that in response to new technologies and shortages of skilled machinists, work in the shops has become less vertically integrated. For example, one interviewee asserted that a decade ago tool and die makers in his shop would start with raw material, make a "blank," and then manufacture the part or tool from the blank. Today, this firm contracts out for the "blanks" so that its tool and die makers can concentrate on the end product. Further, two firms we interviewed indicated that they have dealt with shortages by increasing the level of specialization in the production process and substituting lower-skilled workers:

> ...Because of shortages of skilled machinists, the firm has introduced increasing specialization into its manufacturing process. For example, where one highly-skilled machinist may have made a tool in the past, now three less skilled workers might be used: one worker will do the churning, another the milling, and a third the finishing work.

> ...Because of severe shortages of highly-skilled machinists, our firm is getting away from one tool and die maker who does all the work on a job. Instead, there is increasing specialization, where several skilled machinists do one part of the total job.

5. Substitute Machinery and Equipment for Labor

One of the biggest changes in the production process within the tool and die industry has involved the use of NC, CNC, and other new labor-saving technologies. Most of those interviewed indicated they have introduced new technologies that have affected their need for highly-skilled machinists. Two illustrations from our interviews:

> ...We have gradually introduced NC and CNC equipment into our operations. The primary reason for introducing such equipment has been the shortage of highly-skilled machinists. NC equipment and other computerized equipment can be used in some instances in place of what would have formerly been done by highly-skilled tool and die makers.
>
> ...The production process has increasingly substituted computer equipment for highly-skilled machinists: where 15 years ago a highly-skilled machinist would work on a $5,000 machine to produce a tool or part, today a $5 to $7 [wage per hour] relatively unskilled worker is employed using a $100,000 machine.

6. Train Workers for Jobs

Company-sponsored apprenticeship programs and on-the-job training have always been an important part of recruiting and preparing workers to enter the machine trades (see Section B.2). Because of the range and complexity of the machining equipment and the highly specialized and precise nature of the work, most employers have a commitment to training workers.

7. Improve Wages, Fringe Benefits, and Working Conditions

A number of those interviewed stressed that because of shortages of highly-skilled machinists and the costs associated with training new workers, they are concerned about the competitiveness of their wage and fringe benefit packages. For example, one employer indicated "we bend over backwards to keep the machinists that we have" by providing competitive wages and fringe benefits and by providing personal recognition for work that has been done. Aggregate data on earnings of tool and die makers suggests that while tool and die makers receive relatively high wages compared to most manufacturing workers, the percentage increase in earnings over the last eight years has actually been below that of all workers over 16 years of age. Hence, while some employers may increase earnings in response to localized shortages or shortages of specific types of tool and die makers, this has not been a generalized response in the industry.

8. Contract Work Out and Turn Down Work

Several firms indicated that the first strategy if they do not have sufficient manpower is to attempt to delay the delivery date of the order. If this cannot be done, then they will contract part or all of the order to another shop. For example, one employer indicated that when they have too much work, they will subcontract orders to former employees who have established their own shops. Another employer indicated that he was contracting substantially more work to other tool and die shops than in the past.

As a last resort, firms may turn down business. The firms that we interviewed indicated that they are very reluctant to turn away business. Only one firm provided an example of how the inability to hire skilled machinists had led directly to a loss of business. In this case, the firm was approached by a local manufacturer that had decided to divest its manufacturing operation and to become only an assembly operation. This firm was one of 12 companies asked to become a primary supplier. It would have meant an extra million dollars in sales (an increase of 30 percent in the firm's sales). To meet this demand, the firm would have needed to add an extra 15 tool and die makers and other highly-skilled machinists -- however, one year later it had been able to add only two highly-skilled machinists. In the end, the firm had to curtail its efforts to become one of the primary suppliers for this manufacturer, primarily because of shortages of experienced, highly-skilled machinists. According to the owner-operator of this firm: "A firm cannot respond to opportunities if there is a lack of human resources. While you can usually borrow money or get machinery, finding the necessary human resources is a problem. However, this is not a new problem within our industry; it has been a problem since 1951."

F. Conclusions and Recommendations of Public and Private Sector Steps to Alleviate Shortages

1. Conclusions

Overall, the evidence presented in this chapter does not resolve the issue of whether shortages do or do not exist for tool and die makers. It does suggest that some employers -- especially smaller firms that do not sponsor apprenticeship programs -- have problems in recruiting experienced tool and die makers and in finding qualified younger workers for training in the field. However, in the face of generally sluggish demand for tool and die makers (both during the past decade and expected through the year 2000), supply-side constraints will need to continue and intensify before serious shortages will likely emerge.

The experience of employers points primarily to supply-side problems. Most firms indicate that from time to time they have faced shortages of tool and die makers. They find it generally difficult to locate experienced tool and die makers (i.e., individuals who already have the specific skills that are needed). As a result, it is necessary for firms to provide training through formal apprenticeship programs or on-the-job training for most new recruits.

When asked whether they currently are experiencing shortages for tool and die makers, the responses vary: some employers indicate that they face "severe shortages," while others say that they do not have current openings, and when they have in the past they have been generally able to fill them. There is, however, concern among even those who do not cite specific shortages about the following factors that might result in a future imbalance in supply and demand:

- the high proportion of older tool and die makers who are nearing retirement;
- an apparent bias against employment within the manufacturing sector, which together with the "baby bust" is resulting in a shrinkage of the pool of young high school graduates from which to select young workers;
- lack of basic education and skills development in high school for students not bound for college, together with a decreasing emphasis on vocational education, which results in new recruits being poorly prepared for training as highly-skilled machinists;
- lengthy and costly periods of training for tool and die makers, which make it difficult for employers to adjust quickly to increased product demand; and
- an uncertain impact of technological change (especially NC and CNC equipment) on the demand for highly-skilled machinists and the types of training that are required.

2. Recommendations

Despite the lack of consensus on whether shortages do or do not exist within this occupation, there are a number of steps that can be taken within the public and private sectors to help avert or alleviate shortages in the future. These recommendations are particularly aimed at relieving some of the constraints on the supply of workers to the tool and die maker occupation.

a. Promote Manufacturing at the National Level

Many of those who were interviewed stress the importance of a "national strategy" for promoting manufacturing and encouraging workers to enter the manufacturing sector. Such a campaign is needed to improve the "image" of manufacturing and to demonstrate to the American people that manufacturing is as important to the prosperity of the country as the services sector. Several comments from our interviews illustrate this viewpoint:

> ...A large national effort is needed to get students to understand the types of jobs that are available within the manufacturing sector. In addition, students need to understand that their career path can begin with an apprenticeship or that even those with a college education may want to enter apprenticeship programs to learn more practical skills.
>
> ...The government needs to provide a clear signal to the American people that manufacturing is important to the economy and that we do not intend to be subservient to Japan and Germany.
>
> ...A concentrated effort is needed to promote the machine trades and manufacturing jobs, in general. The industry needs to introduce the idea that entering the machine trades is a "good start" on a career where skills and good work habits are learned which can later be applied to other fields.
>
> ...More prestige needs to be placed on vocational jobs in this country, as is done in Japan, Germany, Australia, and other countries. There is a perception (in the U.S.) that a blue collar worker is not of the same caliber as a white collar worker. This is apparently not the case in Japan and some other countries. For example, a recent Japanese gold medal winner in an international competition among young machinists met with national leaders and was featured on national television and in local newspapers. A bronze medal winner in this same competition from a U.S. firm, by comparison, was lucky to get his name in the company newspaper.

b. Encourage the Formation of Employer-Based Apprenticeship Programs and On-the-Job Training

Providing younger workers with the skills to become tool and die makers and other types of highly-skilled machinists is expensive and requires a long-term commitment on the part of employers (and workers). From the employer's perspective, there are no assurances that the investment made in workers through apprenticeship programs and on-the-job training will necessarily be rewarded by long and productive years of employment by those workers with the firm. As a result, unless they are relatively certain that they can recoup their investment, firms may be unwilling to sponsor employer-based training programs. Sponsoring such programs is particularly a problem for smaller tool and die shops, where the costs of training must be spread across a smaller number of workers.

However, in a field such as tool and die making that requires highly specialized skills, there are few (if any) alternatives to employer-based training. Employers and experts stress the importance of encouraging firms through financial incentives and technical assistance to sponsor employer-based training, which closely integrates the workplace with the schools. Some experts, such as Stephen Hamilton, argue that employer-based apprenticeship programs similar to those found in Germany are what is needed:

> ...Apprenticeship enables ordinary German teenagers to begin careers at the same age that their U.S. counterparts are being turned out of school to sell candy, flip burgers, and pump gas. West Germany's system can aid our thinking about how to integrate high school graduates into the labor market. The system vividly demonstrates that the floundering period results from educational and labor market conditions not from any inherent irresponsibility or instability of youth. Rather than eschewing young employees, West German employers prefer hiring 15- and 16-year-olds as apprentices in order to instill in them the kinds of attitudes, work habits, and skills that they require. The success of the German system suggests that some kind of apprenticeship might improve the transition of U.S. youth from school to work.[19]

Hamilton argues that, based on the German experience, there are four key features needed in any effective apprenticeship program:

- workplaces and other community settings need to be exploited as learning environments;
- work experience needs to be linked to academic training;

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[19] Stephen F. Hamilton (1990). Apprenticeship for Adulthood: Preparing Youth for the Future. New York: The Free Press, a Division of Macmillan, Inc., p. 4.

- youth need to be simultaneously workers with real responsibilities and learners; and
- close relationships need to be fostered between youth and adult mentors.[20]

The cost and lengthy duration of training programs for tool and die makers can be a major impediment to employers setting up such programs, especially for smaller firms. There may be no simple solution to this problem and, in fact, with the use of technology expanding, it may be necessary for firms to spend even more on training the workers. One suggestion is that smaller firms join together and share the costs of establishing and maintaining an apprenticeship program within certain localities. For example, local tool and die shops might join to form a program that provides classroom instruction at a local community college, and on-the-job training at the tool and die shops participating in the initiative. This collaboration is likely to reduce start-up costs and costs associated with recruiting workers into the program, as well as enable apprentices to work on a wider variety of equipment at the various shops involved in the program.

c. Enhance Basic Education and Vocational Education for Students

The role of high schools, vocational schools, and community colleges in preparing students for entry into careers in the machine trades is the focus of many comments by employers and experts. One of the most frequent comments by employers is that high schools need to prepare students better for entry into the job market by providing greater emphasis on basic education. Employers we interviewed stress the need for students who are not planning to attend college to receive basic education and skills training:

> ...Greater emphasis needs to be placed on the three Rs -- especially mathematics. The students who are completing high school and not going on to college are generally poorly equipped to enter the machine trades.

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[20] Hamilton (1990), p. 61.

> ...High schools need to beef up their vocational programs and provide students that are not going on to college with the basic skills (math, reading comprehension, and problem-solving) that are needed to enter the machine trades.

With the tasks involved in machining becoming increasingly complex, basic skills and the ability to learn are becoming more important within the tool and die occupation.

Second, schools need to increase and better target funding on vocational training. Employers complain that school districts are dismantling their vocational education programs by reducing funding for such programs and, in some cases, machine shops. It is felt that schools have to work closer with local employers to enhance (and better target) curriculum and to replace antiquated equipment. For example, according to one employer, "Schools need to be provided with the types of facilities and equipment that are needed to support quality vocational education. Instead the trend is toward cuts in funding for vocational training programs within many local school districts." Another employer suggested that with the increasing reliance on technology within the machine trades, the solution to this problem is to enhance the role of community colleges:

> ...A "two and two program" is needed, whereby students get two years of preparation and training in high school in the machine trades, then attend a two-year program at a local community college.

Third, educators, parents, and students need to be provided with a better understanding of the machine trades and the many challenging and well-paying opportunities within the field. As discussed earlier in the chapter, industry and the schools need to work closely to overcome perceived biases against blue collar employment and to provide students with accurate information about employment opportunities within the machine trades.

d. Improve Data on Demand for Tool and Die Makers

Some analysts urge that the government work to improve the data that are available to individuals and firms on the labor market conditions for manufacturing workers. Special attention is needed to improve data on the current demand for fields such as tool and die makers and to improve the methods used to project future demand. For example, periodic collection of vacancy rate data from major employers of tool and die makers and other specialized manufacturing occupations is needed to accurately anticipate potential shortages.

CHAPTER 7

SUMMARY AND CONCLUSIONS

This chapter synthesizes findings across the four case studies and provides recommendations on how the likelihood of occupational shortages can be reduced. The first section of this chapter discusses the underlying conditions responsible for the emergence of shortages within occupations. This is followed by an analysis of the consequences of shortages in the occupations that we studied and responses to shortages. The final section provides general recommendations on how occupational shortages can be anticipated and avoided, and when they do occur, how their duration and impact can be minimized.

A. Existence and Causes of Shortages

Overall, across the four occupations that were the focus of this study, we found two occupations -- special education teachers and home care workers -- where there are clear shortages of workers to fill available positions. In the other two occupations -- electrical and electronic engineers and tool and die makers -- the evidence for shortages is less certain. In the case of electrical and electronic engineers, while there is evidence of spot shortages, especially in some emerging technological areas, there now appears to be an overall surplus of available manpower because of recent cutbacks in defense spending and the recession. The primary concern is whether and to what extent shortages may emerge in the future. With regard to tool and die makers, while there also appear to be spot shortages and considerable difficulty in hiring experienced workers, there does not appear to be a general shortage. However, employers have major concerns over their ability to replace an aging workforce with younger workers who possess the requisite basic skills to learn the profession.

In the two occupations where there is clear evidence of labor shortages, labor market conditions are more directly influenced by government intervention and other institutional barriers than in the two occupations where shortages are less clearly in evidence. That is, for the two occupations subject to government intervention, labor markets appear to have substantially less freedom to react to the forces of supply and demand -- leading more generally to a disequilibrium condition where the amount of labor workers are willing to supply is less than employers are willing to buy at the prevailing wage. In both shortage occupations, wages paid to workers are directly limited by what the public sector is willing and able to pay for the services produced by these occupations. In contrast, in the two occupations where shortages are less of a problem, wages paid to workers are determined by a large number of private sector employers that are not constrained in what they pay their workers.

In the case of **home care workers**, we found evidence of shortages in many areas of the country -- especially in rural areas, on the West Coast, in the Great Lakes states, and in states with low unemployment rates. Low wage levels because of government restrictions appear to be the most significant factor contributing to shortages. Wages paid to home care workers, particularly those serving patients covered by Medicaid and Medicare, are generally not much different from those paid to workers in fast food restaurants and often are less. In addition to low prevailing wages -- which is probably the dominant factor underlying shortages of home care workers -- there are a variety of other conditions that contribute to shortages of these workers. On the demand side, the following conditions have led to a substantial increase in the demand for home care workers:

- a dramatic increase in the size of the elderly population (especially those over 75 years of age), who are the major users of home health care services;
- a decline in the availability of informal home care (e.g., greater female labor participation rates have reduced the ability of women to care for the disabled and elderly);
- adoption of cost containment policies under Medicaid and Medicare, which have resulted in a greater reliance on less expensive home care rather than on institutional (i.e., inpatient hospital and nursing home) settings; and
- expansion both in the eligibility for and the range of home care services provided under federal and state health care programs.

At the same time, there are a host of underlying conditions that affect significantly the ability and/or willingness of workers to become home care workers, including:

- extremely unstable work environments, particularly in terms of irregular hours;
- near poverty-level wages and few fringe benefits;
- need for transportation, especially within rural settings; and
- limited advancement potential and low job status.

Hence, shortages of home care workers, while strongly linked to low wage levels, also result from an explosive growth in the demand for home health care services and poor working conditions that limit willingness and ability to work within the field and result in high rates of turnover among home care workers.

In the case of **special education teachers**, we found that shortages -- which vary considerably by geographic area within the country -- are partially linked to inflexibility in wages, although wages are not quite as important a factor as they are for home care workers. Probably more important are other factors that affected the demand for these workers and the willingness of workers to enter and remain within the field. A particular problem within the field of special education is "burnout," which results in high levels of turnover. We found that the demand side is substantially influenced by government actions, particularly federal and state laws that have increasingly mandated quality standards for special education. This has resulted in maximum class size standards for special education classes, which increase the demand for special education teachers. In addition, increasing emphasis on early intervention with the developmentally disabled has increased the demand for special education teachers. On the supply side, while there is a large pool of qualified special education teachers, there is a major challenge both to attracting and to keeping fully certified special education teachers within the field. (This is not unlike the problem faced in recruiting and retaining nurses.) The most often cited factor affecting the supply of special education teachers is high attrition. Unlike most teaching fields, in which exit from the profession is due primarily to retirement or family commitments, special education seems to have a particularly high rate of "burnout" due to the pressures and responsibilities inherent in the job. The literature on special education teachers suggests that attrition for special education teachers is among the highest for teaching specialties. In addition, there are a number of other factors that affect the ability or willingness of workers either to enter or to stay within the special education field, including:

- varying state certification requirements, which discourage geographic mobility;
- lengthy training periods, with many states mandating a total of five or six years of college study;
- limited wage differentials for special education teachers compared to their general education peers, despite additional stresses and greater training requirements; and
- the loss of prestige that was formerly attached to teachers and teaching.

While wage levels for special education teachers are perhaps not the overriding factor (as they are for home care workers), institutional rigidity in adjusting wages for special education teachers certainly plays a role in shortages. School boards, because of limits on local revenues, are generally reluctant to adjust wages for special education teachers, even where shortages exist.

The existence of shortages in the two other occupations studied in this report -- electrical and electronic engineers and tool and die makers -- are less certain. While there are labor market conditions on both the demand and supply sides that certainly could result in shortages -- particularly spot shortages and shortage situations in particular localities -- there does not appear to be sufficient evidence to conclude that there are widespread or acute shortages in either occupation. However, the labor market conditions within these two occupations are still of considerable interest in studying shortages because (a) they provide an interesting comparison to our two shortage occupations, and (b) there are both demand and supply conditions which may result in future shortages, particularly within the electrical and electronic engineering field.

In the case of **electrical and electronic engineers**, we concluded based on aggregate data on earnings and employment and views of employers and manpower experts, that there is not currently a shortage. Some analysts feel that shortages are likely to emerge relatively soon (by the mid-1990s) and last well into the next decade. The relatively long training period for electrical and electronic engineers has led some experts to conclude that the nation must immediately take action to head off future shortages. In comparison to the home care and special education occupations, there appear to be relatively few government or institutional restrictions on wages paid to electrical and electronic engineers. Despite the ability of employers to increase (or decrease wages) to adjust to labor market conditions, there are concerns about the following demand-side conditions:

- continued projected growth in demand for electronic and electrical products, which is expected to result in annual employment growth for electrical and electronic engineers that is about double the average for all U.S. occupations;

- an increase in replacement demand due to increasing retirements; and
- rapid emergence of new fields and specialties, together with obsolescence of existing skills of engineers within the field.

At the same time that demand for electrical and electronic engineers is expected to increase substantially, there are potential constraints on the number of new engineering graduates at all levels. Because of the changing age distribution of the U.S. population (i.e., a decrease in the size of the age cohort entering college/university in the 1990s), there is concern over the possibility of a substantial decrease in the number of new engineering graduates at all degree levels. Further, some analysts argue that there is relatively little time to react to the projected shortfall of engineers because of the long lead time in training.

There is a considerable range of opinion, however, on whether such shortages are likely to occur and, if so, what should be done to reduce their likelihood. Some argue that little or nothing at all should be done; they say that market forces (especially increasing wages rates) will provide sufficient incentives for workers to enter and stay within electrical and electronic engineering. They also point to a reserve of workers who can be upgraded (e.g., technicians), transferred from related professions (e.g., physicists, mathematicians), or brought in from other countries (e.g., foreign-born electrical and electronic engineers). Other analysts feel that the market response -- given lags in training time for engineers and the historic patterns of low participation of the general population in natural science and engineering -- is likely to be too slow and inadequate. These analysts strongly urge adoption of strategies to attract and retain students within natural sciences and engineering disciplines (e.g., immediate expansion of financial aid and changes in curriculum).

Finally, in the case of **tool and die makers**, while the evidence does not appear to support the claim by some employers that there is a severe shortage of these highly skilled manufacturing workers, there are some supply-side conditions which could result in future labor shortages. Unlike the three other occupations studied, there appear to be few demand-side factors that have or are likely to result in shortages of tool and die makers. For example, employment within this profession has been relatively flat over the past decade and relatively slow employment growth is projected through the end of the century. Growth could even be slower than predicted if economic conditions deteriorate or further cutbacks in defense expenditures occur. Further, there is uncertainty over the likely effects of changes in technology (especially advances in computer numerically-controlled (CNC) equipment) on the demand for tool and die makers.

The primary source of concern within this field is on the supply side: will there be sufficient entry of new workers to the field to replace the large number of retiring tool and die makers? Major concerns are the following:

- an apparent bias on the part of younger workers (and their parents) against "blue collar" employment, which constrains the number of workers willing to enter the profession;
- lack of knowledge about employment opportunities within the machine trades, especially among high school administrators, counselors, and parents;
- poor basic skills among the pool of youth likely to enter the machine trades;
- the relatively long and costly training period for tool and die makers, which affects willingness to enter the field and makes it difficult for firms (especially smaller ones) to provide the types of training needed for workers to become tool and die makers; and
- lack of vocational training facilities, especially within high school settings.

The key question within this occupation is whether adequate information and incentives can be provided by employers to attract younger workers to the tool and die occupation and, once attracted, whether these workers have the necessary basic skills and determination to master the various technical skills that are required. Another issue is whether smaller employers, who have relatively few workers across whom to spread training costs, can afford to provide recruits with the training that is needed to become tool and die makers, when there is a possibility that they will not be able to re-coup the full cost of the training.

Overall, the four case studies confirm the general economic theory of shortages presented in Chapter 2. In that chapter, we presented three major explanations of labor market shortages within a specific occupation: (1) an increase in the demand for labor, (2) a decrease in the supply of labor, and (3) restrictions on price. We found increases in demand or decreases in supply established conditions necessary but not sufficient for the existence of persistent shortages within an occupation. For example, there are clear examples in all four occupations of supply- and demand-side factors that contribute to actual or perceived shortages of workers. However, for shortages to persist over longer periods -- as they have in the home care and special education occupations -- restrictions on the ability to adjust wages appear to be the major contributing factor.

B. Consequences and Responses to Shortages

At the most general level, the consequence of a labor shortage is that particular goods or services are not provided. The impact of not providing goods or services varies by occupation. A shortage of special education teachers, for example, directly results in some school districts being unable to fill needed teaching positions. This, in turn, may result in larger class size than mandated by law or in instruction of the learning disabled by unqualified teachers. In the case of home care workers, shortages may result in denial or delay of necessary care, reduction in the level of home care services received by clients, and/or diminished quality of care. Shortages of electrical and electronic engineers or tool and die makers may lead to bottlenecks in the production of goods and services, and ultimately to loss in productive capability of U.S. industry. In turn, this may result in job losses for other U.S. workers, loss of domestic production of goods and services, and increases in imports.

In our four case studies, we found a variety of employer responses to shortages. The responses adopted depend upon the conditions that brought about the shortage and the extent to which the employer is affected by the shortage. Employers carefully weigh their responses, considering both short-term and long-term costs. For example, employers are more likely to implement strategies that involve relatively short-term commitments of resources (e.g., intensified recruitment, use of overtime, signing bonuses) than longer-term commitments of resources (e.g., increase in salaries and fringe benefits which affect all employees, intensified training). In structuring responses to shortages, employers are also concerned with both (a) the speed with which they can expect a response in the labor market and (b) the number and quality of the new recruits likely to be generated. For example, some tool and die firms complain that while intensification of recruitment efforts through newspaper advertisements and the use of the Employment Service increases the number of job applicants, relatively few applicants have the necessary basic skills to successfully complete the long and rigorous training that is required to become a highly-skilled tool and die maker.

The responses of employers to shortages in the two occupations -- special education teachers and home care workers -- where we found clear evidence of shortages have both similarities and differences. Government regulation substantially affects labor market conditions in both occupations -- particularly affecting the extent to which employers (i.e., home care agencies and local school districts) can increase wages and fringe benefits to attract and keep additional workers. In both occupations there is also a major problem with "burnout," which in turn leads to high levels of attrition that further exacerbate shortages. At the same time, there are important differences that have lead to somewhat different employer responses. For example, in the special education field there is a relatively long training period (five or more years), clearly-defined certification requirements (varying from state to state), and relatively generous fringe benefits. In contrast, the home care field requires relatively little training, has few certification requirements, and attracts a relatively low-skill worker who typically receives near poverty-level wages and few fringe benefits.

The responses of employers to shortages of **special education teachers**, which vary considerably by locality, include the following:

- increasing use of teachers with temporary (rather than full) certification;
- initiating more aggressive recruitment, including expanding the recruiting area and introducing new recruitment methods (e.g., electronic bulletin boards, using "headhunting" firms, recruiting at universities and job fairs);
- providing additional funds for special education training; and
- providing signing bonuses and other financial incentives.

Employers within the **home care** field, in responding to shortages, have sought to reduce some of the conditions that kept low-wage workers from entering or remaining within the field. Some of the key responses include:

- alleviating transportation problems, including providing reimbursement for travel expenses and/or travel time;
- improving scheduling, so that home care workers are better able to use their available time efficiently;
- providing additional training and supervision for workers;
- intensifying recruitment, with emphasis on word-of-mouth recruiting practices; and
- increasing wages and fringe benefits, though concern over cost containment on the part of Medicare, Medicaid, and third-party payors place a constraint on this response.

While we did not find evidence for (current) generalized shortages within our other two occupations -- electrical and electronic engineers and tool and die makers -- employers have developed a number of creative responses to localized shortages or spot shortages within specific occupational sub-specialties. In addition, within these two occupations, employers, associations, and government agencies have developed a number of longer-term strategies for dealing with what could be future generalized shortages (especially within the electrical and electronic engineering field).

Within the **electrical and electronic engineering** field, analysts have focused on strategies that are likely to attract and retain students within the natural science and engineering pipeline. These longer-term responses to shortages, however, predominantly focus on educational institutions -- e.g., making the curriculum more interesting, providing career counseling, increasing financial aid for undergraduate and graduate engineering study -- than on employers. However, there are a variety of responses which are currently being used by employers to recruit within tight local labor markets or for sub-specialties:

- intensifying recruitment efforts (e.g., through use of electronic bulletin boards, increased use of head hunters, or intensified on-campus recruiting);
- hiring from the ranks of non-engineers and upgrading electrical and electronic technicians;

- using retirees on a part-time or temporary basis;
- substituting new equipment for labor (e.g., especially computerized workstations for design and simulation);
- improving utilization of existing engineers;
- providing enhanced educational benefits to train existing workers in emerging sub-specialties or to reduce problems of obsolescence;
- contracting work out, which is facilitated by improvements in telecommunications and computer workstations; and
- increasing wages and fringe benefits, particularly for workers with expertise in emerging technological areas.

Employers within the **tool and die** industry are particularly concerned with what is perceived to be an inability to recruit younger workers with adequate basic skills. According to employers, recruitment problems (for what is a relatively high-paying career within the manufacturing sector) primarily stem from the poor image of manufacturing and poor preparation of youth for blue collar careers within the United States. Many employers have responded by establishing closer links with high schools, vocational schools, and community colleges to: (a) encourage more emphasis on "basic skills" for non-college bound students and improve the relevancy of vocational education, (b) promote a more positive image (among administrators, counselors, faculty, parents, and students) of manufacturing and the machine trades, (c) promote apprenticeship programs, and (d) directly recruit students with the requisite basic skills. Those employers that report current problems with recruiting tool and die makers have taken a number of additional steps, including:

- intensifying recruitment;
- restructuring work and substituting the use of computerized equipment (e.g., computer numerically-controlled [CNC] equipment) requiring fewer manual skills of workers;

- improving working conditions;
- providing company-sponsored apprenticeship programs and on-the-job training; and
- improving wages and fringe benefit packages.

Overall, there are a wide variety of responses that can be used by employers to eliminate or gradually reduce the effects of labor shortages. Responses vary according to the underlying factors that are perceived by employers to be contributing to the shortage and the extent to which employers are affected by the shortage.

C. Strategies for Anticipating and Dealing with Occupational Shortages

In this section, we present our recommended strategies for anticipating and dealing with occupational shortages. The reader should not be surprised that we have very few global recommendations. We have found that shortages stem from a number of causes, and the harm they cause to various sectors of the economy -- notably workers, employers, and consumers -- varies significantly. In addition, the actions needed to eliminate occupational shortages also must be tailored to the cause of the problem. Use of an inappropriate strategy may create other problems in the economy that are worse than the presence of the shortage. For example, increasing immigration to alleviate a temporary shortage may lead to labor surpluses later.

We first discuss strategies that may help to anticipate shortages or recognize them. We then suggest approaches that may be appropriate to eliminate shortages once they are present.

1. Anticipating and Recognizing Shortages

In this section we provide our conclusions and recommendations regarding projecting occupational shortages before they occur and recognizing them when they occur. To the extent that shortages can be anticipated, it might be possible to take preventive actions. Recognizing shortages quickly can also be important, as corrective actions can be taken before the shortages become severe.

a. Anticipating Shortages

Ideally, we would like to be able to develop accurate economic forecasts that enable us to predict which labor markets are likely to have shortages. To do so requires that we be able to project the number of workers that employers want to employ in the future at various wage rates (the labor demand curve) and the number of workers available for each occupation at various wages (the labor supply curve). Alternatively, if we could project the wage rate, we would only need to project the corresponding supply and demand numbers at that wage rather than the entire supply and demand curves. In addition, we would like to be able to identify the factors that would prevent the market from reaching equilibrium reasonably quickly.

Economy-wide occupational projections, such as those produced by the Bureau of Labor Statistics (BLS) and several private firms, are generally not designed to project occupational shortages. For example, BLS develops occupational projections based on aggregate macroeconomic projections and projections of the industrial mix of the economy. However, the occupational projections developed by BLS are projections of employment and are based on the assumption that there will be sufficient workers available in each occupation to meet demand. Because the BLS occupational projections do not include projections of occupational supply, the BLS occupational projections alone cannot be used to determine if shortages are likely to develop in particular occupations. Moreover, the BLS projections provide only point estimates of employment, not an entire demand schedule. In addition, it is quite difficult to develop accurate projections of occupational employment, and BLS has sometimes been criticized for failing to project the occupational composition of the labor force accurately.[1]

Projecting changes in supply to various occupations is also difficult. As we would expect, occupations with tight labor markets tend to increase wages and attract more individuals into the occupation. Shortages will only develop if the wages adjust too slowly or there are barriers to entry. Some of the supply-side factors can be readily identified, but others are more difficult to predict. For example, we can often judge the supply of entrants to occupations requiring specialized college degrees or long apprenticeship periods several years in advance by admissions to appropriate training and educational programs.

On the other hand, some factors affecting supply are more difficult to predict. Examples include limitations on wages imposed by government, as we saw for home health workers, or by institutional constraints, as was observed for special education teachers. It is very difficult to predict the extent to which such barriers will be maintained over a period of years.

An alternative to projecting the occupational supply and demand schedules is to project the changes in the number of workers that will be demanded and available in the future. Assuming an occupation is currently in equilibrium, the number of additional workers needed to be hired for the occupation consists of net employment growth plus replacement demand generated by occupational mobility, deaths, labor force withdrawal, and retirements. This figure could then be compared to the number of new entrants to the occupation plus re-entrants. Cohen's analysis of shortages makes use of such measures, but he does not project specific shortages; instead he uses various data series to serve as indicators of possible shortages.[2]

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[1] For example, Bishop and Carter concluded that in its last round of projections BLS significantly overprojected growth of low-skill jobs and underprojected growth of jobs requiring a college diploma. See John H. Bishop and Shani Carter (1990). "The Deskilling vs. Upskilling Debate: The Role of BLS Projections." Ithaca, NY: Center for Advanced Human Resource Studies Working Paper 90-14.

Our conclusion is that we cannot project occupational supply and demand well enough to anticipate shortages adequately. Cohen's work points to how labor market projections and data can be used to identify occupations that are prone to shortages in the future. Although analyses such as those performed by Cohen can at best point to likely candidates for shortages, such information can be very useful. For example, occupations that are good candidates for shortages are likely to experience wage increases as the labor market tightens. Projections of tighter labor markets will therefore encourage entry into the occupations. ***Thus, we recommend that further research on "leading indicators" of shortages be supported.*** However, given economists' current lack of ability to develop reasonably accurate projections, we recognize that projections should be treated as general indicators rather than precise forecasts.

b. Recognizing Shortages

It is not a simple matter to determine if an occupation is experiencing a shortage. By the definition used in this study, an occupation has a shortage if the number of workers employed falls short of the number of workers employers would like to hire at the prevailing wage. The key information required to assess whether an occupation is experiencing a shortage is therefore vacancy data. Although BLS formerly collected vacancy data, the program was discontinued several years ago for budgetary reasons.

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[2] See Malcolm S. Cohen (1990). Study on the Feasibility of Using Labor Market Information for Alien Certification Determination. Ann Arbor, Michigan: Institute of Labor and Industrial Relations, University of Michigan.

In the absence of general vacancy data, we can directly assess if an occupation has a shortage only when special occupation-specific data are available. One of the occupations in our study, special education teachers, has vacancy data available because states are required to report vacancies to Congress annually. Although schools have an incentive to under-report such vacancies to the states (so they will not be considered out of compliance with requirements to provide qualified special education teachers to students in need), the data indicate that approximately nine percent of the special education positions in the nation are vacant or occupied by staff without the required qualifications.

In the home care field, national data on shortages are not available, but in our interviews we were able to ascertain the presence of vacancies by asking employers if they were unable to provide home care services for which they would have been paid because of a lack of workers. The fact that many of the employers indicated they could not provide all the home care for which they would have been paid is strongly indicative of a shortage.

For tool and die makers and electrical and electronic engineers, however, we were unable to obtain meaningful vacancy data. Although some of the employers interviewed complained of difficulty in filling positions, they could not provide evidence of vacancies beyond those caused by normal turnover in the occupation. The lack of vacancy data no doubt contributes to the strongly differing opinions that were voiced concerning whether or not shortages exist in these occupations.

Because vacancies are the most important data for determining if shortages are present, the lack of these data makes it very difficult to determine which occupations have shortages. As we noted in our case studies, different parties often have incentives to argue for or against the presence of shortages. If occupational vacancy data were available, assessments of shortages could be conducted more simply and more objectively. ***We therefore recommend that consideration be given to reestablishing BLS data on occupational vacancies.*** If a complete occupational vacancy series is not feasible, perhaps BLS and ETA could strongly urge employers to list vacancies for occupations of special interest (e.g., engineering specialties) with the state employment security agencies, and the results for these occupations could then be compiled at the national level.

2. Potential Actions to Reduce Occupational Shortages

Although we have identified a number of potential causes of occupational shortages, they all may be classified as either market failures or government or institutional barriers. Perhaps because the nation was in a recession while our research was conducted and because we conducted only four case studies, we did not observe shortages that resulted from market failure. Thus, our conclusions and recommendations regarding shortages resulting from market failures are not based on our case studies.

Both special education teachers and home care workers had moderate to severe labor shortages. The shortage of home care workers clearly results from government barriers that prevent the market from clearing: the job requires few skills, training is very short, and there is no general shortage of low-skill workers. The reason for the shortage of home care workers is that wages for the occupation are primarily determined by state and federal reimbursement policies. Because wages are not free to adjust upward to meet the wages of other low-skill jobs, a shortage results.[3]

The shortage of special education teachers results from a combination of government interventions and institutional constraints. The government intervention in the market takes the form of requirements by the states that the educational needs of exceptional children be met by teachers with particular qualifications. This requirement alone would generally not result in a shortage because in a competitive market such teachers would presumably command a premium salary or receive special working conditions to deal with the extra stress associated with the job. Institutional constraints, however, generally result in uniform salary scales for all teachers in an institution. This makes special education relatively less attractive, and many special education teachers leave the field.

The shortages induced by government actions are not caused by government ineptitude. Rather, they often result from government efforts to meet other goals. Most home care workers are supported by Medicare funds, and the federal government has deliberately sought to contain costs of health care by restricting price increases. Thus, the goal of cost containment conflicts with the goal of attracting sufficient workers to the home care field. If reimbursement is not regulated sufficiently, costs may rise by unacceptable amounts, but if wages are kept too low, a shortage results and some individuals entitled to home care are denied their services.

Likewise, the federal requirements for special education teachers are intended to ensure that children with special needs are taught by highly qualified teachers. In the absence of such requirements, some states and local districts might deny these children a satisfactory education. The resistance to paying special education teachers premiums to compensate them for their extra training and more difficult working conditions results from equity concerns of teacher unions and others in the education system.

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[3] As documented in the case study, low wages are not the only cause of the shortage. However, government restrictions on reimbursement are the primary cause of the shortage.

It is not surprising that occupations where government intervenes by restricting wages (e.g., home care) or mandating certain levels of employment (e.g., special education teachers) sometimes experience shortages. Situations where normal market forces are not free to operate can and often do lead to shortages. Government regulators need to be aware of the potential problems and consider the consequences of the shortages relative to what would occur if actions are taken to alleviate the shortages.

In the case of home care, the shortage results primarily in rationing of services, resulting in newly eligible patients experiencing some delays in obtaining services and some patients receiving fewer hours than prescribed. All the employers and researchers we spoke with found the current method of dealing with the shortage to be unacceptable. Alternatives that have been considered include reducing the demand for home care by instituting stricter eligibility requirements, using home care workers more efficiently (e.g., establishing shared aide programs), and increasing wages and fringe benefits. New York State eliminated its shortage of home care workers by using aides more efficiently and increasing wages and benefits. However, if funding had been the primary concern, the shortage could have been eliminated by restricting patient eligibility for home care. In special education, the shortages do not result primarily from budgetary concerns. The net result, however, is that exceptional students do not receive instruction from fully qualified special education teachers.

Sectors of the economy with significant regulation of prices or labor market entry (through licensing or certification requirements) are, by definition, most likely to experience shortages caused by government regulation. Because of the high degree of regulation, the health care industry is especially prone to experiencing shortages because of government actions. It is therefore not surprising that about half of the top shortage occupations ranked by Cohen are in the health field.

To minimize problems with shortages resulting from government regulations, we recommend the following actions:

- ***Governments that directly or indirectly regulate wages in an occupation should monitor the services provided to assure that shortages are not leading to unmet needs (e.g., waiting lists for needed services).***
- ***In periods of rapidly rising wages, governments should make sure that adjustments to wages are made frequently enough to keep them competitive.***
- ***If wage increases are considered undesirable because of the cost implications, government regulators should consider actions to assure that services are provided equitably. For example, programs can be reduced in scope to reduce demand for the occupations experiencing shortages.***

Although the unregulated occupations covered by our case studies are not currently experiencing shortages, the literature indicates that fields such as engineering have experienced shortages in the past. Shortages are most likely to occur in occupations with long training periods and long reaction and response lags by firms, students, and workers. We have already noted that the lack of vacancy data makes it difficult to ascertain when a shortage exists and recommended reinstituting some form of vacancy statistics.

We discussed the actions employers are likely to take to eliminate shortages in Chapter 2. For the most part, employers are aware of the actions they can take to eliminate shortages, and they will generally take these actions if they believe it is in their best interests. To briefly summarize, employers will generally take actions such as increase recruiting efforts, increase the use of overtime, reduce the minimum qualifications for the job, restructure the work to use current or new workers in other occupations, substitute machinery and equipment for labor, train workers for the jobs with shortages, improve working conditions, offer hiring bonuses to new workers, improve wages and fringe benefits, contract out work, or turn down work.

In many instances shortages will be self correcting. As we explain in Chapter 2, employers have incentives to raise wages, improve recruiting, and take other actions to eliminate the shortage. ***Thus, before taking strong action, government policymakers should review projections of occupational supply and demand to determine if the shortage is likely to be corrected by normal functioning of the labor market.***

Federal and state governments can assist employers and workers to adjust to shortages by publicizing occupations where shortages exist or are likely. BLS publications such as the Occupational Outlook Handbook and Occupational Outlook Quarterly can be valuable tools to employers, workers, and students. In addition, state employment services, the National Occupational Information Coordinating Committee (NOICC), and NOICC's state counterparts -- the State Occupational Information Coordinating Committees (SOICCs) -- provide occupational data and projections for workers, firms, and students. Although it is extremely difficult to evaluate the effectiveness of these institutions, an evaluation might reveal ways in which these organizations could be improved. ***The Department of Labor should consider evaluating the effectiveness of its occupational information programs with the goal of identifying any shortcomings and improving the flow of information to workers, students, and employers.***

Another potential bottleneck to alleviating shortages is a lack of appropriate training and educational programs. In some instances employers can train workers themselves, but in many occupations employers are dependent on schools and independent training programs. ***If a shortage is likely to persist, and one of the problems is a lack of adequate education and training programs, government can help eliminate the shortage by increasing support for these programs.*** The Employment and Training Administration has recently taken steps to upgrade the apprenticeship system in the United States, and this may help avoid shortages in some skilled occupations. On a selective basis, the government can also support growth in institutions of higher education to increase the capacity to train professionals in selected fields.

Finally, permitting additional immigration for individuals in shortage occupations can provide additional workers relatively quickly. Immigration policies are often controversial, however, because increasing the supply when there is not a shortage can reduce the earnings of workers currently in the occupation. Even if there is a shortage, it may only be temporary, and workers may find their wages reduced in the future. ***Liberalizing immigration policies can be used to eliminate shortages, but care should be taken to ascertain that a shortage exists and that it is expected to persist.***

As we noted at the beginning of this study, labor markets are highly dynamic. To some extent, labor shortages are inevitable as labor demand by employers changes and labor supply of workers adjusts. In most instances the natural working of the market will eliminate the shortage, but in some cases government actions can help reduce the time required or remove barriers to the process.

APPENDIX A:

TECHNICAL NOTE ON DATA SOURCES

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Current Population Survey (CPS)

The Current Population Survey data used in this report on occupational employment, occupational unemployment rates, and earnings by occupation represent for a number of occupations very small samples. Consequently, the data are subject to considerable year-to-year sample variation.

Interviews of Individuals Knowledgeable About Selected Occupations

The interviews conducted as part of this study were not based on random samples, but instead were conducted with individuals willing to discuss the labor market situation for the occupations of interest. For all four occupations we interviewed representatives of employers and trade associations. Where relevant, we also interviewed government officials, researchers, educators, and representatives of unions. Some of those interviewed requested anonymity, so we have not included the names of any interviewees within this report.

APPENDIX B:

DISCUSSION GUIDE FOR FIRMS EMPLOYING TOOL AND DIE WORKERS

Firm: ____________________
Interviewee: ____________________
Position: ____________________
Interviewer: ____________________
Date: ____________________

DISCUSSION GUIDE FOR FIRMS EMPLOYING TOOL AND DIE WORKERS

Introduction: My name is ______ and I'm with James Bell Associates. **(If possible, say who suggested that you call.)** We are conducting a study of trends within the tool and die occupation and other occupations for the U.S. Department of Labor. I would like to ask you a few questions about your firm's experience with recruiting tool and die workers. It will take about 30 to 45 minutes; is this a good time? (If not, when can I call you back or is there another person within your firm that I can talk to?)

A. Employment Trends and Structure of Firm

1. How do you define the occupation "tool and die maker?"

2. What tasks does a tool and die maker perform within your firm? Have those tasks changed over the past five years?

3. Have duties of the tool and die maker changed over the past five years? If yes...

   a. How?

      - work has become more complex
      - work has become more specialized
      - work requires more precision
      - new products and techniques have been introduced

   b. Have former duties of tool and die makers been taken over by other workers or machines during the past five years?

4. How many journeymen tool and die makers does your firm currently employ?

5. How does this number compare with the number employed 5 years ago? 10 years ago?

6. What are the reasons for the increase or decrease in the number employed?

7. How have the demographic characteristics of workers/new entrants changed over the past five years (e.g., age, sex, race, education, and training)?

8. Is retention of tool and die workers a major problem within your firm? If yes...

   a. Why do workers leave?

      1. Higher pay within the tool and die occupation
      2. Higher pay in other occupation
      3. Retired
      4. Laid off, lack of work
      5. Laid off, poor performance

   b. How many tool and die workers have left your firm over the past five years?

** **Preface to sections B and C: The next two sets of questions probe into the extent of labor shortages. The first is related to the industry in general whereas the second is aimed specifically at your firm's experience.**

B. Extent of Shortages - General Trends Within the Industry

1. To what industry does your firm belong?

2. How do you define a "shortage?"

3. What do you feel are the major signs that shortages exist?

Possible signs:
- increases in wages
- decreases in entry requirements
- intensified recruiting
- signing bonuses
- decreased size of the entry pool

4. Do you feel there is a current shortage of tool and die workers to fill vacancies within your industry as a whole? If yes...

   a. How serious is this shortage?

   b. Do you think these shortages are local or national?

   c. Do you expect that these industry-wide shortages will continue into the future? For how long? Why?

   d. Were there historic shortages of tool and die workers in your industry?

C. Extent of Shortages - Specific Experience of the Firm

1. Is your firm experiencing a current shortage of tool and die workers to fill vacancies? If yes...

   a. How serious is this shortage for your firm?

   b. How does the shortage affect your firm?

   c. Do you expect that your firm will continue to be affected by shortages of tool and die workers into the future? For how long? Why?

   d. Are these shortages more severe for tool and die workers than for other types of workers that you employ?

2. Do you currently have any unfilled openings for tool and die makers? If yes...

   a. How many current openings?

   b. How long have these vacancies remained open?

   c. Is this amount of time typical?

3. Looking back over the past five years, has your firm experienced shortages of tool and die workers to fill vacancies? If yes...

   a. When?

   b. Have these shortages been intermittent or continuous?

   c. Have the shortages gotten worse or better in recent years?

4. During the past five years, have shortages of tool and die makers:

   a. Resulted in your firm turning down business?

   b. Caused your firm to delay filling orders?

   c. Affected your ability to compete with other firms? How?

5. During the past five years, have you laid off any tool and die makers? If yes...

   a. Why (e.g., lack of business; changing technology has reduced the need)?

   b. Were you able to rehire these same workers later?

D. Factors that Explain Shortages, Consequences, and Reactions to Shortages

1. What do you feel are the major causes of shortages of tool and die workers?

   Possible reasons:

   -cyclical trends in demand for goods
   -shrinking labor force
   -long training/apprenticeship period
   -bias against blue collar professions
   -aging workforce
   -loss of tool and die workers to other occupations
   -pricing of goods (e.g., competition with foreign imports)

2. Do you expect these same conditions to continue over the next five years?

3. When you experience a shortage of tool and die workers, how does your firm react? Possible reactions:

   -raise wages
   -improve fringe benefits
   -increase overtime work
   -substitute with lower level workers
   -substitute with higher level workers
   -substitute with capital equipment/new technology
   -contract work out
   -stop seeking additional work
   -stop taking orders for additional work
   -intensify recruiting efforts
   -lower minimum requirements
   -offer signing bonuses

4. What are the consequences of shortages of tool and die workers for your firm?

Possible consequences:

-substitution of other types of labor
-substitution of capital for labor
-unmet product demand

5. Do shortages of tool and die workers result in a substitution of foreign products for domestic products?

E. Training and Recruitment of Workers to the Occupation

1. Have your hiring requirements changed over the past five years?

- No
- Yes, lowered
- Yes, raised

a. If yes, how?

b. Was this change in response to a shortage?

2. Do you think hiring requirements for your firm are likely to change over the next five or ten years?

3. How does your firm currently recruit tool and die workers?

Possible methods:

-newspaper advertisements
-radio advertisements
-school recruiting
-job fairs
-public/private employment agencies
-walk-ins
-word-of-mouth

4. Have these recruitment techniques changed over the past five years? If yes...

   a. How?

   b. What are the reasons for these changes?

5. What are the skills necessary for entry into the tool and die profession? How do workers obtain these skills?

6. What methods are used by workers to seek and gain employment within the tool and die profession? Are there any licensing or certification requirements?

7. What types of barriers do workers face in obtaining employment?

8. Does your firm currently have an apprenticeship program to train tool and die makers? If yes, interviewer may wish to discuss its role and effectiveness.

9. Do you hire people who are not tool and die makers and train them? If yes...

   a. Is this a useful approach to deal with shortages?

   b. Explain.

F. Additional Questions

1. How have wages paid to tool and die workers in your area changed over the past five years? Has your firm adjusted wages because of shortages of qualified tool and die workers?

2. Has the structure of your fringe benefits for tool and die workers changed in recent years? If yes...

   a. How?

   b. Why?

3. What can be done to alleviate labor shortages in the future? Have there been public/private policies that have worked in the past? What can the following entities do to alleviate shortages:

- federal/state/local government
- employers
- trade unions
- apprenticeship/trade schools
- workers within the machine trades

G. Company Data

1. Number of Employees

2. Year of Incorporation

3. General Description of the Business

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